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SYSTEM

OF

MINERALOGY,

COMPREHENDING

ORYCTOGNOSIE,
GEOGNOSIE,
MINERALOGICAL CHEMISTRY,
MINERALOGICAL GEOGRAPHY, AND
ŒCONOMICAL MINERALOGY.

By ROBERT JAMESON,

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1804.

SYSTEM

OF

ORYCTOGNOSIE,

ACCORDING TO THE METHOD OF THE ILLUSTRIOUS WERNER OF FREYBERG.

Wenn ich ein mineralogiſches Lehrbuch, um daraus zer lernen, aufschlage, ſo thue ich es; entweder, um überhaupt eine kenntniſs von dieſer wiſſenſchaft zu erlangen, oder, um inſbeſondere von einem foſſile, daſs ich bloſs dem namen nach kenne, den vollſtandigen begriff zu bekommen: oder von einem foſſile, welches ich gefunden und an dem ich ſeine äüſſerlichen kennzeichen aufgeſucht habe, zu erfahren, wie es heiſſe und welchen platz es in dem ſyſtem der foſſilien einnehme. Leiſtet mir hierinnen ein Lehrbuch grosſten theils genuge, ſo nenne ich es gut, und wenn es mich völlig beſriediget, denn nenne ich es volkommen.

Werner's Auſſerlichen Kennzeichen, ſ. 13.

TO

COLONEL ALEXANDER DIROM,

OF MOUNT ANNAN,

QUARTER-MASTER GENERAL FOR SCOTLAND,

FELLOW OF THE ROYAL SOCIETY OF EDINBURGH, &c.

THIS SYSTEM OF ORYCTOGNOSIE

IS INSCRIBED,

IN TESTIMONY OF THE RESPECT AND GRATITUDE

OF HIS OBEDIENT, HUMBLE SERVANT,

ROBERT JAMESON.

COLLEGE OF EDINBURGH,
APRIL 30, 1804.

PREFACE.

I SHALL employ a few pages in giving a very ſhort hiſtorical account of the authors who have treated of mineralogy, with the view of enabling the reader to appreciate more fully the merits of the Wernerian ſyſtem, on which the preſent work is founded.

The mineralogical writings of Pliny, Theophraſtus, and Dioſcorides, have made us acquainted with the luxury of the Romans and Grecians, and their fine works of art; but they contain nothing of ſyſtem, and very little of tolerable deſcription. The firſt ſyſtematic mineralogiſt was undoubtedly the celebrated Saxon miner George Agricola. He was alſo the firſt who inveſtigated the external characters of minerals, determined them with any degree of accuracy, and uſed them with judgment in the deſcription of foſſils. In his ſyſtem he divides minerals into thoſe which are compoſed of homogeneous parts, and thoſe compoſed of heterogeneous parts. The homogeneous, or ſimple minerals, he ſubdivides into four claſſes, which are entitled, 1. Terra, 2. Succus con-

cretus, 3. Lapis, and 4. Metallum. The heterogeneous are divided into compound and mixed minerals.

Nearly at the ſame time the famous Cardan wrote a treatiſe on minerals, which differs principally from that of Agricola in the ſaline being ſeparated from the inflammable bodies.

Kentman's work De omni rerum Foſſilium Genere, Gemmis, Lapidibus, Metallis, &c. publiſhed in 1665, is nearly a tranſcript of Agricola de Natura Foſſilium. He adds to it, however, a treatiſe on petrifactions, entitled Alcyonia, conchæ, et alia, quæ ex falſo liquore maris et ex ejus ſpumæ, cum tenuiſſimis ſordibus permiſta concreſcunt.

The juſtly celebrated botaniſt Cæſalpinus publiſhed, in 1602, a work entitled De Rebus Metallicis, which contains little deſerving of notice.

In 1609 Bootius Von Boot publiſhed a treatiſe on precious ſtones, in which we find deſcribed upwards of ſix hundred varieties, having all particular names, a proof of the attention paid to minerals at that early period.

At this time the firſt Spaniſh mineralogiſt, Alonzo Barba, a Mexican prieſt, publiſhed his work De los Metallos. It contains deſcriptions, and methods of working minerals. He was the firſt who treated of amalgamation.

The great compiler Aldrovandus, in his Muſeum Metallicum, delivered a ſyſtem of mineralogy extracted from the writings of Agricola, Cardan, and Cæſalpinus. He was the firſt who drew the attention of

mineralogiſts

mineralogiſts to petrifactions. In this path he was followed by Johnſtone in his Notitiæ Regni Mineralis, publiſhed in 1667, and by the well known jeſuit Athanaſius Kircher, in his Mundus Subterraneus, publiſhed at Amſterdam in 1678.

Some years afterwards Woodward publiſhed his Catalogue of Minerals. He may be conſidered as the firſt Engliſh mineralogiſt of note.

Becher, in his Phyſica Subterranea publiſhed at Leipſic in 1708, endeavoured to arrange minerals according to their conſtituent parts. He was the firſt writer who propoſed the opinion, that the difference in compoſition of earths and ſtones might be employed in their arrangement and diſcrimination. He alſo firſt introduced the diviſion of metals into perfect and imperfect.

Bromel in his Catalogus Generalis rerum curioſorum, publiſhed at Gothenburg in 1698, retained the Becherian diviſion of metals into perfect and imperfect, and arranged ſulphur and bituminous bodies in the ſame claſs.

In the beginning and towards the middle of the eighteenth century Beyer *, Büttner †, and Scheuchzer ‡, employed themſelves principally in the inveſtigation of that highly intereſting claſs of bodies, petrifactions; although their works are disfigured by many

* Oryktographia Norica. Nuremb. 1758.

† Mineralogia et Oryctographia Helvetiæ. Zurich 1718. Herbarium Diluvianum Ludg. Batav. 1723. Homo Diluvii teſtis. Zurich 1726.

‡ Buttner Ruderi Diluvii teſtes.

foolifh fpeculations, and the individual fpecies are but indifferently afcertained, yet from this period the attention of mineralogifts was more directed to the examination of great rock maffes than had formerly been the cafe. In this point of view the labours of thefe enquirers muft be confidered as of importance.

In 1730, Magnus Von Bromel, a fcholar of Hiærne and Boerhaave, publifhed a fyftem of mineralogy. He divides minerals into eight claffes, 1. Earths, 2. Salts, 3. Sulphurs, 4. Stones. 5. Petrifactions, 6. Calculi. 7. Semi-metals, and 8. Metals.

In 1739, Cramer publifhed a fyftem of mineralogy, which contains feven claffes. 1. Metals, 2. Semimetals, 3. Salts, 4. Inflammable fubftances, 5. Stones, 6. Earths. 7. Waters.

In 1736, the illuftrious Linnæus publifhed the firft fketch of his mineral fyftem. He divides minerals into three claffes, 1. Petra, 2. Mineralia, 3. Foffilia. The firft clafs contains three orders, *a.* Vitrefcentes, *b.* Calcariæ, *c.* Apyræ. The fecond three orders, *a.* Salia, *b.* Sulphuria, *c.* Mercurialia. The third clafs contains alfo three orders, 1. Concreta, 2. Petrifacta, 3. Terræ.

This fyftem is in many refpects faulty, and its principal merit confifts in having firft drawn the attention of mineralogifts to the ftudy of the cryftalline figures of minerals. Although Linnæus cannot be faid to have contributed much to the progrefs of mineralogy, yet indirectly his labours in the other branches of natural hiftory laid the foundation of that reformation which was afterwards effected by

Werner.

Werner. He was the firſt who eſtabliſhed right ideas of ſyſtem. He ſhewed that its principal object was to aſſiſt the memory, and to enable naturaliſts to diſtinguiſh bodies from one another, and thus to aſcertain if what they were inveſtigating had been previouſly deſcribed by others. He alſo taught that no ſyſtem could be of uſe that did not poſſeſs an uniformity in the baſis of its claſſification aud nomenclature, and a fixed and generally received language.

Nearly at the ſame time mineralogical chemiſtry was much advanced by the labours of Pott and Henckel; but of theſe Pott poſſeſſed the moſt extenſive and correct chemical knowledge. He arranged earthy minerals according to their proportion of ingredients, and thus paved the way for many of the chemical ſyſtems of the preſent day. His four claſſes are the alkaline, ſiliceous, argillaceous, and gypſeous. Death prevented this moſt indefatigable chymiſt from extending his enquiries to the metals.

In 1747, Wallerius, profeſſor of mineralogy at Upſal, and cotemporary with Linnæus, publiſhed a ſyſtem of mineralogy. He divides all minerals into four claſſes, *viz.* 1. Terræ, 2. Lapides. 3. Mineræ, 4. Concreta. The firſt claſs contains four orders, 1. Macræ, 2. Pingues, 3. Minerales, and 4. Arenaceæ. The ſecond claſs is ſubdivided into four orders, 1. Calcarii, 2. Vitreſcentes. 3. Apyri, and 4. Saxa. The third claſs is ſubdivided alſo into four orders, 1. Salia, 2. Sulphura, 3. Semimetalla, and 4. Metalla. The fourth claſs comprehends four orders, 1. Pori, 2. Petrifacta, 3. Figurata. 4. Calculi. In this

this ſyſtem the external characters of the ſpecies were more accurately detailed than had been done by any other mineralogiſt, the terminology was improved, and the ſynonymes of preceding authors were elucidated.

Wolterſdorf, a ſcholar of Pott, ſoon after wrote a ſyſtem of mineralogy, which, however, added nothing to what was then known.

In 1758, the celebrated Cronſted publiſhed a ſyſtem of mineralogy *. It is divided into four claſſes, *viz.* 1. Terræ, 2. Salia. 3. Phlogiſtica, and 4. Metalla.

The firſt claſs contains nine orders, 1. Calcareæ, 2. Siliceæ, 3. Granatinæ, 4. Argillaceæ, 5. Micaceæ, 6. Fluores, 7. Aſbeſtinæ, 8. Zeolithicæ, and 9. Magneſiæ. The ſecond claſs contains two orders, 1. Acida, 2. Alkalina. The third claſs contains but one order. The fourth has only two orders, 1. Perfecta, 2. Semimetalla. One of the moſt ſtriking excellencies of this ſyſtem is the ſtrict adherence to a fixed principle as the baſis of claſſification; it is throughout chemical, and the principles on which the orders and genera are founded are ſtill pretty generally followed by chemical mineralogiſts.

The compound rocks and petrefactions which had been included in the mineral (oryctognoſtic) ſyſtem, by Linnæus and others, were very judiciouſly deſcribed in an appendix by Cronſtedt. The deſcriptions of the ſpecies, however, were, from want of at-

* Syſtema Minerale, Berolini, 1748, 8vo.

tention,

tention to the external characters, extremely imperfect; yet, as it was not so much Cronsted's intention to write an oryctognostic system as one of chemical mineralogy, this defect must not be supposed to detract from the merit of his work.

To Cronstedt succeeded Lehman and Vogel, but their oryctognostic labours were of little importance.

In 1768, Linnæus published a second edition of his Systema Mineralogicum. In it the classes are the same with those of the first edition, but the number of orders and genera is increased. He prefixed to it an account of the external characters which he employed in the description of minerals. Respecting his system of characters, Werner observes, "Nur ist "die ordnung, wen man es anders noch eine nennen "kann, in der er sie aufführt, nicht zu loben: zu- "dem sind solche nicht vollständig abgehandelt, in- "dem noch gar viele fehlen; auch sind die mehres- "ten erklarungen zu kurz, und deswegen dunkel "und unverständlich; und endlich so fehlen erlau- "terungen durch beispiele, welche doch zum ver- "standlichkeit der beschreibungen sehr vieles beitra- "gen."—*Werner*, s. 48.

Peithner, in 1778 published tables of the external characters of minerals*; and Sir John Hill, in 1772, published a system of mineralogy, accompanied with tables of the external characters, resembling those of Peithner, but more extensive and determinate*.

* Joh. Thad. Peithners, erste grunde der Bergwerks wissenschaften. Zweite abhandlung uber die mineralogie. Prag. 1770. 8vo.

Wallerius

Wallerius, in the new edition of his Syſtema Mineralogicum, publiſhed at Stockholm in 1772, was the firſt who ſubjected to a ſerious examination the principles on which mineralogiſts had hitherto arranged minerals. He rejected the characters drawn from uſe, value, and geognoſtic ſituation, and affirmed, that claſſes, orders, and genera ſhould be arranged according to chemical, but ſpecies principally in conformity with the external characters. Theſe principles he employed in the conſtruction of his ſyſtem, which proved the moſt complete, and poſſeſſed the moſt determinate nomenclature of any that had hitherto appeared. By thus combining with the chemical characters thoſe external characters that were then known, he enabled mineralogiſts to diſcriminate minerals with more certainty than they had been hitherto able to do. Still, however, the want of a proper mineralogical language rendered all ſyſtems and deſcriptions imperfect, and comparatively uſeleſs. The external characters employed by Agricola, Linnæus, Wallerius, Hill, and others were either undefined, or ſo inaccurately explained that it was difficult to underſtand, or avoid confounding them with one another; beſides, they were employed irregularly, and even frequently intermixed with chemical, phyſical, and empyrical characters.

The illuſtrious Werner early ſaw the impoſſibility of mineralogy advancing ſteadily without a determi-

* Hill's foſſils, arranged according to their various obvious characters, London, 1771, 8vo.

nate

nate language, he therefore made this the firft object of his attention, and publifhed the refult of his obfervations in his claffical work, Von den Kenzeichen der Foffilien. This admirable treatife laid the foundation of true oryctognofie, I may even fay of mineralogy. In it Werner has collected together all the old and known characters, defcribed many which he himfelf difcovered by comparing minerals together: accurately defined every character then known, gave to each an appropriate and fixed denomination, and arranged the whole in fyftematic order. Since the publication of this treatife he has difcovered feveral very important external characters, and has much improved the defcriptions of many of thofe contained in his early work. The fyftem of characters as now delivered by Werner may be placed with the Philofophia Botanica in its moft finifhed ftate.

I fhould now proceed to mention the different oryctognoftic publications, of the Wernerian fchool, but I fhall for a fhort time interrupt the regularity of this view by giving a fhort account of the writings of two French mineralogifts, whofe labours have in France formed a kind of national mineralogy.

The firft is the celebrated Romé d'Lifle, who publifhed an excellent work on cryftallization in 1783. In it minerals are divided into three claffes: the firft contains faline cryftals, the fecond ftoney cryftals, and the third metallic and femi-metallic cryftals. He was the firft, after Werner, who particularly directed the attention of mineralogifts to the primitive form of

cryſtals, of which he enumerates the following ſpecies: —1. Tetraedron. 2. Cube. 3. Octaedron. 4. Parallelepiped. 5. Rhomboidal octaedron, and 6. Dodecaedron, with triangular planes. He conſidered all minerals that agreed in cryſtallization, hardneſs, and ſpecific gravity, as belonging to the ſame ſpecies.

The deſcriptions of the ſpecies were the moſt accurate and complete that had been delivered, and contributed more to the advancement of oryctognoſie than the writings of all preceding mineralogiſts.

To him ſucceeded ſeveral other French mineralogiſts; of theſe the moſt remarkable and only one deſerving of notice is the Abbé Hauy. This intelligent philoſopher was long employed in cryſtallometrical reſearches, of which he gave an account in a treatiſe publiſhed ſome years ago. Since that period he has extended his inveſtigations to the greater number of ſimple minerals; and in 1801 he publiſhed the reſult of his very laborious and ingenious obſervations and ſpeculations in a work entitled Traité de Mineralogie. In it ſimple minerals are divided into four claſſes. The firſt comprehends the combinations of earths and alkalis with acids; it is ſubdivided into three orders. 1. Contains the combinations of earths with acids. 2. Combinations of alkalis with acids. 3. Combinations of earths with acids and alkalis.

The ſecond claſs contains thoſe earthy ſubſtances, into whoſe compoſition there ſometimes enters a portion of alkali. This claſs has neither orders nor genera, but is only a ſeries of ſpecies.

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The third clafs comprehends the combuftible fubftances, with the exception of the metals. It is fubdivided into two orders. 1. Simple combuftibles. 2. Compound combuftibles.

The fourth clafs includes all the different metallic minerals. It is fubdivided into three orders. 1. Contains metals not oxydable by heat. 2. Thofe which are reducible and oxydable by heat. 3. Metals which are oxydable, but not reducible by heat.

Thefe four claffes are followed by three appendices In the firft appendix is contained all doubtful or unafcertained minerals. The fecond includes all the compound rocks. It is fubdivided into three orders: the firft contains primitive rocks; the fecond, the fecondary and tertiary rocks; the third, aggregates formed by the agglutination of fragments.

The third appendix is dedicated to volcanic productions. It is fubdivided into fix claffes. 1. Contains lavas. 2. Thermantides. 3. Products of fublimation. 4. Altered lavas. 5. Volcanic tufas, and 6. Subftances which have been formed in lava after their eruption, and cooling.

In this fyftem the arrangement of fimple minerals is almoft ftrictly chemical; but the arrangement and defcription of the rocks and lavas is founded on certain fanciful ideas refpecting their formation, and is extremely ill executed; but an examination of this part of the fyftem of Hauy belongs properly to geognofie.

The fpecies of fimple minerals is determined from one character, which is ftyled the integral mollecule. Hauy defines the mineral fpecies to be " Une col-

" lection des corps dont les mollecules integrantes " font femblables, et compofés des memes elements " unie en memie proportion." This integral mollecule or kernel is detected, either by mechanical divifion, or by meafurement combined with calculation; and when found, is afferted to afford an invariable effential character for the fpecies. I cannot, however, fubfcribe to this opinion; on the contrary, I venture to affirm, that it is not, in any inftance, the type of the fpecies, and that it only makes us acquainted with peculiarities in the ftructure of a few cryftallized minerals, peculiarities which may indeed be afterwards difcovered in other fpecifically diftinct minerals. That it affords no effential characters is evident, becaufe different fpecies, as diamond and fpinelle have the fame integral mollecule; and other minerals, as zeolite, that unqueftionably belong to the fame fpecies, have different integral mollecules. That it makes us acquainted with peculiarities in the ftructure of but a few cryftallized minerals is fhewn, 1. From the impoffibility of detecting the integral mollecule by calculation combined with meafurement, therefore all the fpecies afcertained by this method are to be expunged from the fyftem*. 2. From many fpecies having the fame integral mollecule; and individuals of the fame fpecies having different mollecules. Thus it appears that its exiftence as a peculiarity, remains but to a few fpecies.

* Patrin. Dict. Hift. Nat.

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That even this peculiarity, which we find in a very few cryſtallized minerals may be diſcovered in others ſpecifically different, is proved from the caſe of diamond, ſpinelle, &c.*

It appears from this that the integral mollecule cannot in any inſtance be conſidered as the type of the ſpecies, therefore, the oryctognoſtic ſyſtem of Hauy, which is built on this ſuppoſition, muſt fall to the ground †.

The various attempts that have been made to deſcribe and to diſcriminate the mineral ſpecies by a

* The inſtances of the inconſiſtencies that occur in the employment of the integral mollecule are numerous, but of theſe I ſhall only mention one. Zeolite is one of the moſt natural and beſt aſcertained ſpecies in the ſyſtem, and its ſubſpecies are connected together by agreements in oryctognoſtic and geognoſtic characters. Hauy having, however, found ſmall differences in the integral mollecules of theſe ſubſpecies, has divided it into four ſpecies. Spinelle and diamond are acknowledged by Hauy to have ſimilar integral mollecules, yet he conſiders them as diſtinct ſpecies, and diſtinguiſhes them from one another by hardneſs and other external characters. Thus in one inſtance we find the integral mollecule aſſumed as of ſuperior characteriſtic importance to all the other external and geognoſtic characters combined; but in the other it yields even to a few of the other external characters.

† Independent of the objections ſtated above, there is ſtill another, and probably a more forcible one to be oppoſed to the ſyſtem of Hauy; it is that the greater number of minerals are not cryſtallized, conſequently, according to the definition of Hauy, have no diſcoverable integral mollecule, therefore are not ſpecies. Hauy indeed ſuſpects that they are not ſpecies ! ! !

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few characters, as by the primitive form, integral mollecule, or the primitive form* combined with hardness and specific gravity have all proved insufficient. Werner was early aware of the insufficiency of such methods, and in his work on the external characters, published in 1774, he gave the first examples of the true method of describing species. In these descriptions all the characters presented by the *species suite* are detailed with a certain degree of minuteness, and in a determinate order, so that we have a complete picture of it, and are furnished with characters that distinguish it from all known species, and from every mineral that may hereafter be discovered.

In 1780 he published the first part of a translation of Cronstedt's mineralogy. It was in his annotations

* In amorphous minerals, the species are determined from the colour, shape, surface, lustre, fracture, distinct concretions, hardness, transparency, and specific gravity; each species presents a peculiar suite of characters, that characterize and distinguish it from all others. Also in crystallized minerals the character of the species is to be taken from the crystallizations, combined with the other characters. If, on the contrary, we would attempt to describe the species from one or a few characters, we will undoubtedly confound species that are different, and subdivide those that are similar. This renders the use of the primitive form nearly equally objectionable with the integrant mollecule. We cannot too often bring to our recollection, that every mineral species is to be determined from the aggregate of all the characters, combined with the geognostic relations; a mode of investigation, which, independent of the certainty it gives to our determination of the species, prepares us for the higher study of geognosie.

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on this work that he gave the firſt ſketch of his oryctognoſtic ſyſtem, and publiſhed many deſcriptions in conformity with the method laid down in his treatiſe on the external characters. In this ſyſtem we find earthy minerals (for this was the only part of the ſyſtem then publiſhed) divided into four genera, viz. ſiliceous, argillaceous, talcaceous, and calcareous; and theſe genera ſubdivided into ſpecies, ſubſpecies and kinds. The ſpecies, as already mentioned, are not deſcribed by a few, but by all the external characters.

In 1791, he publiſhed a catalogue of the great mineral collection of the then deceaſed Pabſt Von Ohaine, captain general of the Saxon mines. In this intereſting work we have a tabular view of the whole oryctognoſtic ſyſtem, in which the method of genus, ſpecies, ſubſpecies, and kind is continued; ſeveral additions are made to the external characters, and the arrangement of the ſpecies is in ſome inſtances changed, owing to the examination of more complete mineral ſuites.

Since that period his oryctognoſtic publications have been confined to a few, but very maſterly memoirs, in the miner's journal, ſo that we have ſtill to regret the want of his own expoſition of his oryctognoſtic ſyſtem. His numerous pupils, however, have made it known in every civilized country of Europe. In Germany it has been publiſhed by Widenman, Emmerling, Karſten, Eſtner, Reuſs, and Lens; in Spain, De La Rio has publiſhed an account of the ſyſtem of his great maſter; Napione has done the ſame in Italy; in Sweden and Denmark it is alſo followed

lowed and taught; it has been introduced into France by an able mineralogiſt M. Brochant; and Kirwan, one of the moſt illuſtrious of Britiſh philoſophers was the firſt who made it known in England *. Several

* In 1800 Brunner publiſhed a treatiſe entitled Verſuch eines Newen Syſtems der Mineralogie, &c.

It is founded ſolely on the external characters. It is divided as uſual into four claſſes, *viz.* earthy, ſaline, inflammable, and metallic. The firſt claſs is ſubdivided into ſeven orders: the firſt order contains all earthy minerals which "have an earthy "fracture, and are dull and opaque." 2d, Having a fine ſcaly fracture. 3d, Having a foliated fracture. 4th, Having a radiated fracture. 5th, Fibrous fracture. 6th, Fine grained foliated fracture. 7th, Diſtinct compact fracture. The ſecond claſs contains eight orders: 1ſt, Having a ſouriſh aſtringent taſte. 2d, Sweetiſh aſtringent taſte. 3d, A rather diſagreeable ſaltiſh cooling taſte. 4th, Pure ſaline taſte. 5th, Pungent ſaline cooling taſte. 6th, Bitter taſte. 7th, Weak ſoapy taſte. 8th, Sharp alkaline taſte. The third claſs contains three orders: 1ſt, Bituminous. 2d, Coaly. 3d, Sooty. The fourth claſs is ſubdivided into eight orders: 1ſt, Earthy fracture, dull, or faintly glimmering. 2d, Compact fracture, common, frequently a little metallic, luſtre. 3d, Common luſtre, and foliated fracture. 4th, Common luſtre and radiated fracture. 5th, Common luſtre and fibrous fracture. 6th, Metallic luſtre and in looſe ſcales. 7th, Metallic luſtre and fluid. 8th, Metallic luſtre and ſolid.

In his ſyſtem the moſt diſſimilar minerals are aſſociated together; thoſe that evidently belong to the ſame natural family are ſeparated; and in no inſtance is there ſuch a deſcription of the ſpecies given as to enable us to diſtinguiſh them from one another. To exemplify this we may mention, 1ſt, That wood tin, fibrous malachite, red ore of antimony, cobalt bloom, and feathe-roſe antimony, are placed in the ſame order. 2d, Mica, ſelenite, potſtone, hornblende, felſpar, diamond ſpar, calc ſpar, heavy, ſpar

Several of the works I have now mentioned were publiſhed when the Wernerian oryctognoſie was far removed from its preſent ſtate of perfection, and are conſequently in many reſpects imperfect. The mineralogy of the intelligent M. Brochant, which may be conſidered the beſt account of the Wernerian oryctognoſtic ſyſtem hitherto publiſhed, is unſatisfactory.

In the work I am now to lay before the public, I ſhall, in the two firſt volumes, deliver a ſyſtem of oryctognoſie, in which I ſhall follow the arrangement and method of deſcription of Werner, and when I venture to deviate from the ſyſtem of my illuſtrious maſter, I hope to be able to aſſign ſatisfactory reaſons for the alterations I may propoſe *.

The taſk which I have undertaken was to have been executed by my ever to be regretted friend, Dr Mitchell, whoſe long experience and conſummate ſkill eminently qualified him for it. Unfortunately

ſpar are arranged together; and 3d, Of columnar heavy ſpar we have the following deſcription: "Uſually of bright white colour. "Luſtre pearly. Either tranſlucent or tranſlucent on the edges. "Soft; and its cryſtals are aggregated into columns." This is another ſtriking inſtance of the inſufficiency of all methods that do not embrace in the account of the ſpecies all its external characters, and in the arrangement the natural alliances.

* Some of the names and expreſſions which will occur during the courſe of this volume, and which may by ſome be difficultly underſtood, will be fully explained in the treatiſe on the External Characters, which will accompany the ſecond volume, and in the volume on Geognoſie. I truſt therefore that the language which I have employed will not be criticiſed with ſeverity, until I have an opportunity of explaining it.

for mineralogy this accomplifhed and moft amiable man was removed from this tranfient fcene before he was permitted to communicate to the world the refults of his own profound obfervations and thoughts, on a fcience in the knowledge of which he was only rivalled by its great founder Werner.

Previous to entering on the defcription of the individual minerals, I fhall, in the Introduction, firft ftate the bafis on which this fyftem is founded; then mention the method followed in fubdividing it into claffes, genera, fpecies, and fubfpecies, and give an account of the different characters employed in mineralogy, of the rules of mineralogical nomenclature; and, laftly, fhew the utility of oryctognofie and the requifites neceffary to form an oryctognoft.

INTRODUCTION.

INTRODUCTION.

MINERALOGY is that branch of natural hiſtory * which makes us acquainted with all the properties and relations of minerals. As theſe properties and relations are very different from each other, we cannot

Definition of mineralogy.

* If it be true " that deſcription, when employed about " events, conſtitutes hiſtory," then certainly the uſual acceptation of the appellation, Natural Hiſtory, is erroneous. That relation which aſpires to the dignity of hiſtory, muſt embrace not only an exact and full deſcription of the object or thing treated of, but alſo aſcertain the relative time as well as manner of its production, and the change and alteration, if any, it has undergone in arriving at its preſent ſtate. Natural hiſtory therefore comprehends two diſtinct branches, the one making us acquainted with natural objects as they are preſented by nature, furniſhing us with ſufficient data and eaſily applicable criteria to diſtinguiſh them from each other, and this is *Natural Deſcription.* The other branch, Natural Hiſtory properly ſo called, conſiſts in the inveſtigation of the ancient and original ſtate of natural objects, and the ſucceſſive changes and alterations they have undergone till the preſent time. Thus in botany and zoology the queſtions, Were all animals and plants originally created as we at

cannot arrange them together without producing much confufion. On this account Werner found it neceffary to confider them under five different heads, or what he terms mineralogical doctrines: thefe are, *Oryctognofie*, *Geognofie*, *Mineralogical Geography*, *Mineralogical Chemiftry*, and *Oeconomical Mineralogy*.

Oryctognofie. *Oryctognofie.*—Or what has been hitherto in Britain and France denominated mineralogy, is that branch of mineralogy which makes us acquainted with minerals in a natural order, under fixed denominations, and by well afcertained characters.

Geognofie. *Geognofie**—teaches us the ftructure, relative pofition and mode of formation of the mineral maffes of which the cruft of the earth is compofed†.

Mineralogical

at prefent find them, or have they by degrees affumed the fpecific forms they now poffefs? Are certain fpecies become extinct? In what order and whither have they migrated? What change has climate produced? In mineralogy, at what period, during the formation of our earth, and under what circumftances has a peculiar fpecies of mineral been produced? Has it remained unaltered, or has it undergone changes? All thefe queftions are of hiftorical import, and belong to this department. In fuch inveftigation confifts the fcientific profecution of Natural Hiftory; the mere art of diftinguifhing natural objects from one another can fcarcely be entitled to that appellation.

* By Geology, Werner underftands idle and imaginary fpeculation refpecting the formation of the earth.

† At firft fight the folid mafs of the earth appears to be a confufed affemblage of rocky maffes, piled on each other without order or regularity: to the fuperficial obferver nature appears in the rude matter of the unorganic kingdom, to prefent us only

with

Mineralogical Geography—defcribes, in geographic order, the particular rocks that occur in the earth's furface in different countries, and makes us acquainted with the different fpecies of foffils that are contained in them, and the manner of their occurrence. It gives us Mineralogical geography.

with a picture of chaos, where none of thofe admirable difplays of fkill and contrivance, which in the ftructure of animals and vegetables fo powerfully excite our attention, and claim our admiration, are to be obferved. It is not furprifing that this unfavourable opinion fhould have long continued to be prevalent, when we confider the fkill, judgment, and experience which are neceffary for enabling us to combine all that variety of apparently unconnected relations which are obfervable in the internal ftructure of the earth. In ancient writers we find nothing on this important fubject. The ftriking phenomena of volcanoes appear frequently to have excited wonder and aftonifhment, which they always fubftituted for inveftigation. After the revival of letters, when fcience had affumed a more favourable afpect, and mines came to be worked by freed men, the objects of the mineral kingdom excited a confiderable fhare of attention, the numerous interefting phenomena, which daily prefented themfelves to the miner, were carefully remembered, and at length recorded by the celebrated miner Agricola. From that period until the time of Werner, mineralogifts brought to light many individual, and a few general facts refpecting the ftructure of the earth. Lehman firft pointed out the great natural divifion of mountains into primitive and fecondary ; Cronftedt afcertained the age of feveral mineral repofitories ; Hamilton defcribed the phenomena of volcanoes ; Dolomieu made us acquainted with the ftructure of volcanic hills ; Sauffure enlarged our knowledge of the variety of primitive rocks, and an excellent obferver, our countryman Williams, made many excellent obfervations on the independent coal formation.

Notwithftanding

us a picture of the ſtructure and compoſition of particular tracts, geognoſie that of the whole globe.

Mineralogical chemiſtry.

Mineralogical Chemiſtry—makes us acquainted with the quantity and quality of the conſtituent parts of minerals.

Oeconomical mineralogy.

Oeconomical Mineralogy—teaches us the different uſes of minerals.

This excellent ſubdiviſion of the ſcience, firſt marked its true limits, and its vaſt extent, and pointed out a clear path for future mineralogiſts.

Notwithſtanding the labours of theſe induſtrious obſervers, our knowledge of the internal ſtructure of the earth was ſtill very limited and confuſed. Although obſervations had been made in very diſtant countries, and ſimilar rocks diſcovered in a variety of the moſt widely diſtant ſituations, yet no ſucceſsful attempt had been made to generalize theſe appearances, ſo as to diſcover the general ſtructure of the earth, and the mode of its formation. Sauſſure made the attempt, but neither his information nor ability ſeem to have been equal to this great taſk. He was alſo unacquainted with many facts which would have aſſiſted him, and his attention was too much occupied with particular and local appearances to effect what has been ſince ſo fully accompliſhed by the comprehenſive mind of Werner.

This great geognoſt, after many years of the moſt arduous inveſtigations, conducted with an accuracy and acuteneſs of which we have few examples, diſcovered the manner in which the cruſt of the earth is conſtructed. Having made this great diſcovery, he, after deep reflection, and in conformity with the ſtricteſt rules of induction, drew moſt intereſting concluſions, as to the manner in which the ſolid maſs of the earth may have been formed. It is that ſplendid ſpecimen of inveſtigation, the moſt perfect in its kind ever preſented to the world, which I ſhall give an account of in the volume of this work which treats of Geognoſie.

2. As

2. As oryctognofie is the ground-work of mineralogy, a knowledge of it muft neceffarily precede that of the other doctrines. This is the reafon why it is to occupy the early part of this work. I muft remark, however, that it is not purely oryctognoftic, for I have added to the defcription of each mineral, its chemical characters, conftituent parts, geognoftic and geographic fituations, and a few notices refpecting its ufes. Oryctognofie the bafis of mineralogy.

3. An arrangement to be correct fhould have but one object for its bafis; for when feveral are affumed it fails completely in accomplifhing its purpofe: it is alfo indifpenfably neceffary in arranging natural bodies, that none which fall within the bounds of the fyftem be omitted. Many mineralogifts, by affuming as the bafis of their fyftems not only the natural alliances, but alfo the chemical compofition, geographic fituation, and œconomical ufes of minerals, and by feparating the volcanic from other oryctognoftic products, have rendered their fyftems unftable and incomplete. The Wernerian oryctognoftic fyftem is framed in conformity with the ftricteft rules of claffification; it is founded folely on the *natural alliances and differences obfervable among minerals.* But on what do thefe depend? Werner anfwers on the quality, quantity, and mode of combination of the conftituent parts. General rules of arrangement. Bafis of the Wernerian oryctognofie.

Karften, Hauy, Brochant, and other mineralogifts have objected to the Wernerian fyftem, that it arranges minerals together which are completely different Objections to it.

ferent in their internal compofition; thus they remark fapphire is placed in the flint genus, although it has been found to contain ninety-eight per cent. of alumina; and opal in the clay genus, although ninety-eight parts of filica. This objection, however, is founded on a mifconception of Werner's opinion. He does not pretend that his arrangement fhall always correfpond with the experiments of the chemift; for it is only when chemical refults agree with the natural alliances of the mineral that he gives them a place in his fyftem. In inftances where the affinities of the mineral with thofe already in the fyftem have not been made out, and we are ftill uncertain as to its true nature, it is a matter of indifference where we place it. If it has been analyfed we may arrange it chemically, not however from a conviction that its place will thus be fixed, which cannot be done until we have, by the examination of a complete fuite, combined with a knowledge of its geognoftic relations, difcovered whether or not its characters authorife the arrangement made by the chemift. If we were to allow the arrangement to be made according to the moft improved chemiftry of the prefent day, we fhould have very diffimilar minerals grouped together, and thofe which are nearly allied feparated. In fuch a fyftem garnet and thumerftone would be confidered as the fame fpecies; chlorite would be arranged among the ores of iron, and we fhould have a tranfition fuite beginning with pumice, and proceeding through pearlftone, pitchftone, clinkftone, felfpar, talc,

The objections anfwered.

Chemical arrangement of minerals.

talc, lepidolite, to leuzite. It is evident, therefore, that a chemical oryctognosie, in so far as it stands in opposition to the natural alliances observable among minerals, must be rejected.

Subdivision of the mineral system.

4. Having now stated the principle on which the Wernerian system is founded, I shall next detail the method which is followed in dividing the whole mass of simple minerals into *classes*, *genera*, *species*, *subspecies*, and *kinds*.

Linnæan divisions not sufficient.

The Linnæan division of class, order, genus, and species, having been found insufficient for the arrangement of minerals, Werner, to remedy this inconvenience, formed two inferior subdivisions, which he denominated subspecies and kind.

Class.

The highest division is the *kingdom*. The second, or *Class*, is founded on what Werner terms the fundamental constituent parts. Of these there are four, *viz*. 1. Earthy, 2. Saline, 3. Inflammable, and 4. Metallic; and these form four great natural classes.

Genus.

The *Order* does not form one of the divisions of this system; therefore the next is the *Genus*, which is characterised by the predominating or characterising earthy, saline, inflammable or metallic matter.

Characters of the genus to be taken from its external aspect.

There are many instances, however, where this definition does not apply. We may mention opal, diamond, and sapphire. It would therefore be better to rest satisfied with a description, such as we shall afterwards give, of the external aspect of the genus, and only assume the idea of a predominating ingredient, as intimating what we are intitled to expect will after-

 wards

wards be the cafe when analyfis becomes more perfect *.

The next divifion is the *fpecies*, which although the moft important of the whole, has been ill underftood by mineralogifts.

It would be inconfiftent with the brevity of this Introduction to mention all the variety of opinions that have been propofed refpecting mineral Species; it is fufficient to mention that Werner confiders all thofe minerals that agree in external characters and internal compofition as belonging to the fame fpecies †.

Species.

The next fubdivifions are fubfpecies, kind, and variety. *Varieties* are thofe differences which we obferve in the individual external characters, as luftre, fracture, hardnefs, &c.

Variety.

* In place of doubting of the accuracy of chemical analyfis, or of examining whether or not the chemift was entitled to believe that the fubftances which his analyfis gave him pre-exifted in minerals, mineralogifts called in queftion a truth which appears infeparable from the exiftence of natural hiftory, *viz. that the external afpect is an expreffion of the internal compofition, and is a criterion of it.* In fhort we may believe that every analyfis, (not confirmed by fynthefis), which does not agree with the natural alliances of minerals, is falfe.

† In the animal and vegetable kingdoms each plant and animal conftitutes a whole, poffeffes a determinate form, each individual exhibits an effential difference, and is capable of definition. In the mineral kingdom each foffil cannot be confidered as an individual, but merely as a part of that immenfe individual, the globe; hence it is evident that, accurately confidered, there exifts but one mineral fpecies or individual, which is the *globe*.

A *fpecies*

A *ſpecies* is compoſed of a greater or leſſer number of varieties. Species.

If in a ſpecies we meet with groups of varieties that can be well diſtinguiſhed from each other, we muſt give them a particular appellation; Werner denominates them *ſubſpecies*. Subſpecies.

To illuſtrate the manner of forming ſubſpecies, we ſhall take an example from the claſs of metals; it is lead glance which contains two ſubſpecies, *a*. Common lead glance. *b*. Compact lead glance. Mode of forming ſubſpecies illuſtrated.

The eſſential character of the ſpecies is as follows: Colour lead grey. Luſtre metallic. Streak unchanged. Mild. Soft. Very heavy.

Firſt Subſpecies. Common lead glance

Has ſometimes particular external ſhapes as reticulated, cellular, tubular, &c. It is often cryſtalliſed. Luſtre almoſt always ſhining, ſometimes ſplendent. Fracture more or leſs perfectly foliated, generally ſtraight, often curved foliated, with a threefold cleavage; ſeldom radiated and uſually ſhort, broad, and ſcopiformly diverging radiated. Very eaſily frangible.

Second Subſpecies. Compact lead glance.

Colour is lighter than the preceding ſubſpecies. Occurs only maſſive and ſpecular; has no particular external ſhape. Luſtre only glimmering. Fracture even. Fragments indeterminately angular. Does not occur in diſtinct concretions. Has more tenacity than the preceding ſubſpecies.

When an extenſive ſpecies is undivided, it is not only difficult to fix the picture of it in the mind, but

 the

the determination of the individuals of which it is composed requires a degree of skill and experience that few can hope to possess. It is therefore of the greatest importance, when such a species occurs, to endeavour to separate the groups of characters from each other, and place them in the system as subspecies. It must not be concealed, however, that such an operation requires much acuteness, and a most complete practical acquaintance with oryctognosie. In the writings of several German mineralogists we meet with many new subspecies; these are, however, vague indefinite things, that shew how little the framers of them have understood the Wernerian method.

Necessity and utility of forming subspecies.

Difficulty of forming subspecies.

Family.

The term Family, used in this work, intimates that all the minerals included under it belong to a natural family.

4. All the differences mentioned in the preceding section must be arranged in a determinate order, and in such a one as shall correspond with the natural alliances of minerals. However easy this may at first sight appear, we must confess that the greater number of attempts have proved inefficient. The idea of a chain of nature, which was employed by zoologists and botanists, was here adopted as the basis of many arrangements, but no such chain exists; for, if it did, every species could only pass into the one preceding and following it, but this is not the case, for one species often passes into several, and others not into any, but stand isolated.

No chain of nature.

The scheme in plate 11. shews the incompatibility of a natural chain, where every link fits correctly into each

each other, with the tranfitions of minerals. It reprefents the alliances of filver with gold, antimony, arfenic, filver, copper, iron, tin, lead, fylvan, and mercury.

In the following fection I fhall detail the method which is followed in the arrangement of thefe differences, or claffes, genera, fpecies, fubfpecies, and kinds.

5. In the arrangement of the members of the fyftem, we firft begin with the moft general, and proceed to the more fpecial. Secondly arrange them as much as poffible in a natural order; and thirdly, in the higher divifion, as in the genera and fpecies, we place the characteriftic ones firft, and allow the other lefs characteriftic to follow in the order of their affinity; but when fuites occur that do not poffefs fuch affinities, we place the characteriftic member in the middle, and arrange the others on both fides according as they approach more or lefs to it. We fhall now illuftrate this method by giving an account of the arrangement of the different members of the fyftem.

Rules to be followed in the arrangement of the members of the fyftem.

6. The clafs of *earthy minerals* is diftinguifhed from the others by its being in general not remarkably heavy, brittle, poffeffing ufually white or light colours; being much difpofed to cryftallize, uninflammable in a low temperature, and infipid and inodourous. It is placed firft in the fyftem by reafon of its fimplicity, its conftituting the greater part of the cruft of the earth, and its being the repofitory of the minerals of the other claffes.

Characters of clafs of earthy minerals.

The

Characters of faline minerals. The clafs of *faline minerals* is characterifed by being moderately heavy, foft, poffeffing fome degree of tranfparency, being chiefly white and fapid. It is placed immediately after the preceding clafs, by reafon of its refemblance to it in feveral properties.

Character of inflammable clafs. The *inflammable clafs*, which occupies the third place, is light, brittle, moftly opaque, always yellow, brown, or black, fcarcely ever cryftallized, does not feel cold, and as far as our prefent experience extends, it appears to be more nearly allied to the metallic than the earthy clafs.

Character of the metallic clafs. The *metallic clafs* is heavy, chiefly opaque; in general poffeffes a peculiar luftre, is tough, often poffeffes fome degree of malleability, exhibits a great variety of colours; is cold, and not eafily inflamed. It is placed at the extremity of the fyftem, becaufe it is furtheft removed, in properties, from the earthy clafs, and is nearly allied to the inflammable clafs.

Arrangement of the genera. 7. In a natural arrangement, as we have already mentioned, that genus, which poffeffes the characters of the clafs the moft diftinctly and completely, fhould be placed firft, and the others fhould follow according to their greater or lefs affinity with it. In the clafs of earthy minerals or ftones, the flint genus* poffeffes

* In the clafs of earthy minerals, there are fix genera to which I have ventured to give the following denominations, 1. Flint genus. 2. Clay genus. 3. Talc genus. 4. Calc genus. 5. Baryte genus, and 6. Strontiane genus. The ufual names, Siliceous genus, Argillaceous genus, &c. intimate, that the

possesses those properties and characters that entitle it to the first place. To the flint succeeds the clay genus, because of its greater affinity to the flint genus than any other, and it passes by a natural gradation into the next, following the talc genus. The transition of these genera into each other is very complete, but the following genera, calc, baryte and strontiane, do not afford so beautiful a continuance of the series.

Arrangement of the earthy genera.

Besides these genera there is another that cannot be placed between any of those that are here mentioned without interrupting the natural order, it is the zircon. This genus in its external characters has much resemblance to the flint genus, but as it cannot follow, it must precede it, hence it is placed immediately be-

Why zircon is placed before flint genus.

the minerals comprehended under them contain a preponderating quantity of the earth which gives name to the genus. This, however, is not the case with the species as arranged in this work, for some belong to the flint genus that contain no silica, and others to the clay genus that contain no alumina. I have therefore judged it more consistent with the arrangement to adopt terms that express, not any chemical composition, but have a reference to the most striking and characteristic external characters of the genus, or to that species around which all the others belonging to the same genus, may by transition be arranged. Thus all the species belonging to the flint genus possess in an eminent degree the properties that in common life are termed flinty, and besides can be arranged around quartz or flint as a central point. In a similar manner all the fossils arranged under the talc genus are connected with the species talc by external characters and transition. I have preferred the terms talc and calc to talcaceous and calcareous, to preserve a uniformity in the nomenclature.

fore

fore the flint genus. But zircon is not the only example; there is ftill another, which is the diamond; it muft alfo have a place near the zircon, but on what pretence can an inflammable fubftance have a place here? The diamond was by the ancients placed among earthy minerals, but in latter times it has been difcovered to be a combuftible body, nearly pure carbon; hence chemifts have very properly arranged it with inflammable bodies. Many oryctognofts have adopted the fame arrangement; but Werner, for the following reafons, ftill continues to confider it as the moft perfect of minerals, and as deferving to hold its place at the head of the mineral kingdom. 1. It agrees in many of its external characters with zircon, therefore it muft be placed near it, and not to interrupt the arrangement before it. 2. When compared with other inflammable minerals it prefents many ftriking differences; thus inflammable minerals are light, foft, generally dark coloured, eafily inflamed, and not cryftallized; on the contrary, the colours of the diamond are very numerous, it is almoft always regularly cryftallized, has confiderable fpecific gravity, and of all minerals poffeffes the greateft degree of hardnefs.

Why diamond is placed at the head of the mineral fyftem.

Sailne genera.

The faline clafs contains but one genus, Werner, however, has divided it into four, viz. 1. Carbonate. 2. Muriats. 3. Nitrats, and 4. Sulphats*.

* This method is probably objectionable, and therefore is not followed in this work.

The

The genera of the inflammable clafs are, 1. Sulphur. 2. Coal, and 3. Graphite; and require no particular arrangement. Inflammable genera.

The metallic clafs, which is the next in importance after the earthy, contains a number of genera, which are arranged after the fame method as the earthy genera, viz. thofe which poffefs the properties of the clafs in the higheft degree are placed firft. Metallic genera.

As platina poffeffes the metallic qualities in the higheft degree, it is placed at the head of the clafs of metals. Next is gold, which agrees with platina in oryctognoftic and geognoftic characters. Mercury follows gold on account of its great fpecific gravity and ftrong luftre. Silver is the next genus; from it we have a natural tranfition to the next genus, copper. To copper fucceeds iron, lead, tin, bifmuth, zinc, antimony, cobalt, nickel, manganefe, molybdœna, arfenic, fcheele, menacane, uran, fylvan.

8. Having finifhed what was neceffary to be faid refpecting the arrangement of the genera, I fhall now illuftrate, by an example drawn from the fyftem, the mode of arranging the fpecies. The example is from the flint genus. If the method which was employed in the arrangement of the genera be followed here, quartz, as the moft characteriftic fpecies, fhould occupy the firft place in the genus. Here, however, we find a whole feries of fpecies that cannot together be placed before or after quartz; the feries muft therefore be divided, quartz placed in the middle, and the other fpecies fo arranged that the firft divifion fhall precede, and the other follow quartz. By Arrangement of fpecies.

this method we are enabled to place all the ſpecies in a natural order, and obtain on the one hand a tranſition into the zircon genus, and on the other into the clay genus.

In the metallic genera, thoſe ſpecies which are in the metallic ſtate are placed firſt, next the different oxyds and combinations. Great attention muſt, however, be paid to the tranſitions, and their arrangements.

Arrangement of ſubſpecies. 9. As the ſubſpecies are few, their arrangement is comparatively eaſier; we muſt here attend, chiefly, to the rules of tranſition, ſo that the arrangement may be natural.

Characters of minerals. 10. The characters which are employed in the deſcription of minerals are, by Werner, divided into five claſſes, 1. External. 2. Chemical. 3. Phyſical. 4. Geognoſtic, and 5. Geographic.

1. *External Characters*—are thoſe which are diſcoverable by the external ſenſes, without inducing any conſiderable alteration in the aggregation of the mineral; thus colour, ſhape, luſtre, fracture, hardneſs, weight, &c. are of this kind.

2. *Chemical Characters*—are thoſe which are afforded by the complete analyſis of the mineral; by trials with acids, with the blow pipe, and Wedgewood's pyrometer.

3. *Phyſical Characters*—are thoſe phyſical properties of minerals which are diſcovered by trials with the magnet, or by rubbing or heating.

4. *Geognostic Characters*—The determinate occurrence of one mineral with another affords, what Wer-

ner

ner terms the geognoſtic character. I ſhall mention a few inſtances. Glance cobalt has ſo ſtriking a reſemblance to arſenical pyrites that it is often confounded with it; it however occurs along with copper-nickel, which is never the caſe with arſenical pyrites; this then is the geognoſtic character which aſcertains it to be glance cobalt. Native arſenic frequently occurs along with red orpiment, but it never acompanies red lead ore; this, therefore, ſerves as an excellent character for diſtinguiſhing theſe two minerals, in doubtful caſes.

5. *Geographic Character*—is determined from the birth place or local ſituation of a mineral. Thus if we are preſented with a cochineal red coloured mineral from Joangeorgenſtadt, its birth place or geographic character announces it to be red ſilver ore: if the mineral be from Landſberg or Idria, we would conſider it as cinnabar; was it from the Hungarian mines, or thoſe among the Uralian mountains, we would reckon it red copper ore.

The geographic character muſt, however, be confined within very narrow limits, as we know that the occurrence of minerals is ſeldom confined to particular ſpots or countries, and we are often uncertain if the ſpecimens we have are from the places mentioned.

The geognoſtic character, on the contrary, is highly characteriſtic, and it is to be regretted that it has been hitherto ſo little attended to.

External characters ſufficient for the arrangement and deſcription of minerals.

It has been much diſputed which of the preceding kinds of character are beſt ſuited for the deſcription and diſcrimination of minerals. It was long the pre-

vailing opinion, that external characters alone were sufficient; the increasing taste for chemistry introduced the chemical characters, and these in their turn have been adopted by several mineralogists, to nearly the exclusion of all the others. Werner teaches, that all the different kinds of characters are to be employed, but of these, he considers the external characters as by far the most certain and generally applicable. These characters are not only sufficient for the description, but also for the arrangement of minerals. That they are sufficient for the discrimination of minerals is certain, from the observation of Werner, who declares, that no mineral has ever been discovered which could not be distinguished by its external characters, and that they are sufficient for its arrangement is equally evident from the greater number of species in the mineral system being arranged solely by agreements and differences in the external characters.

As a knowledge of these external characters is absolutely required of every one who shall venture on the study of oryctognosie, I should now proceed to give an account of them, I must, however, from the great extent of the subject defer this for the present; but shall give a full explanation of them in the following volume.

11. In writing the description of a mineral, according to its external characters, Werner recommends

Method of describing a mineral.

a. *That it should contain all the external characters.* The external characters are not of equal importance; hence several mineralogists have judged it necessary, in their descriptions, to employ only the more characteristic

teriſtic or eſſential ones. In ſome inſtances this may be done, but in the greater number of caſes, the omiſſion of any of the characters would lead to error. We muſt, therefore, in our deſcriptions, not only mention all the characters, but every branch of them, as far as they are characteriſtic of the ſpecies.

b. *That we ſhould place all the characters together.*— The older, and many of the modern writers in mineralogy, by endeavouring to follow the methods of the zoologiſt and botaniſt, have rendered their deſcriptions of minerals unintelligible. To obtain an acquaintance with the external aſpect of a mineral from ſuch a deſcription, or rather ſeries of definitions, we muſt combine the characters of the claſs, order, genus and ſpecies, and after this labour, what do we obtain but a deluſive and imperfect picture?

c. *That theſe characters ſhould not have any of the others intermixed.*—As the deſcription of a mineral according to its external characters is principally intended to give us a diſtinct picture of its aſpect, and of certain phyſical properties it poſſeſſes, we muſt be careful that it contains nothing foreign to that object; it muſt, therefore, contain no chemical, geognoſtic, or geographic characters.

d. *That they ſhould be arranged in a determinate order.*—When the characters are arranged in a determinate order, we are not ſo liable to omit any of them, and are enabled more eaſily to recollect the picture of the mineral. Werner arranges them in that order in which they naturally preſent themſelves to our ſenſes; thus beginning with colour, as that which

which firſt attracts our notice, and placing the others in their correſponding places, viz. figure, luſtre, fracture, fragments, diſtinct concretions, frangibility, brittleneſs and weight

e. That they ſhould be ſufficiently accurately determined.—Many minerals are completely alike, excepting in certain ſhades of character, which muſt alſo be mentioned if we do not wiſh to be deprived of the diſtinctions they afford. Thus it is not enough in deſcribing white ſilver ore, to ſay that is has a grey colour, nor even that it poſſeſſes a lead grey colour; accurate determination requires that the colour of white ſilver ore ſhould be given—fallow lead grey.

f. That it ſhould contain only ſuch expreſſions as have met with univerſal approbation.

g. That the degree of the frequency of the occurrence of any one of theſe characters ſhould be expreſſed, as by the following terms, abundantly, commonly, ſometimes, partly, ſeldom, rarely, very rarely.

h. That the deſcription ſhould be written ſo as to afford a ſynoptical view, and that the characters may eaſily attract the eye This is beſt done by beginning each character by a new line, and diſtinguiſhing the moſt important ones by capital letters, or, by printing in italics. My knowledge of oryctognoſie is too limited to permit me the uſe of italics.

Werner's method of deſcribing a mineral.

In deſcribing a mineral, according to the method of Werner, we do not employ a few iſolated characters, as is done in zoology and botany, but, as I have already mentioned, a ſeries or ſuite, which being peculiar to the ſpecies, conſequently characteriſes it.

But

But fuch a picture or defcription is to be drawn up from the examination, not of one or a few, but from many fpecimens, hence the neceffity of having an extenfive mineral fuite, before we pretend to know the fpecies already in the fyftem, or to defcribe new ones.

12. The only fources from which the denominations of minerals ought to be taken, are the following: Sources from whence the names of minerals fhould be taken.

α. *From fome characteriftic external character.* Thus the mineral which chemifts term fulphat of ftrontian is, on account of its characteriftic blue colour, denominated by Werner Celeftine. Actynolite derives its name from its radiated fracture; Schalftone, from its lamellar diftinct concretions.

β. *From refemblance to other bodies.* Thus that remarkable mineral which was firft found in Hungary and defcribed by Fichtel as a fpecies of zeolite, was, by Werner, denominated pearlftone, on account of its ftriking refemblance in colour, fhape, and ftructure to pearl.

γ. *From their ufe.* As procelain earth from its ufe in the manufacture of procelain.

δ. *From the place where firft found.* Thus Lydian ftone derives its name from Lydia in Afia, where it was firft found.

ε. *From the name of the difcoverer.* Thus the mineral denominated by chemifts carbonate of barytes, is named by Werner Witherite, in honour of its firft difcoverer, Dr Withering.

We

We muſt be very careful that the name conveys no falſe meaning, as is the caſe with black lead and others.

Minerals have often been named from their peculiar chemical properties or their conſtituent parts; but this is in general not to be recommended, as it renders the ſyſtem of names fluctuating by reaſon of the daily alteration in preceding chemical analyſes.

Chemical nomenclature not to be admitted.

Werner has, except in a few inſtances, very properly baniſhed the chemical nomenclature from oryctognoſie. In oryctognoſie, as in zoology and botany, the nomenclature ſhould be founded on ſome ſtriking external character, or when that does not readily occur, the name ſhould be arbitrary, derived from the name of the country where firſt found, that of the diſcoverer, &c.

Synonymes.

13. From the great confuſion which reigned in mineralogy before the time of Werner, the aſcertaining the ſynonymes of preceding authors is often attended with much difficulty, and indeed in few inſtances can be completely ſatisfactory. I have therefore been ſparing of ſuch ſynonymes. In later writers they are more eaſily and ſatisfactorily aſcertained, and thoſe I have frequently noticed and have arranged in chronologic order*.

Uſes of oryctognoſie.

As Oryctognoſie is the rudiments of Geognoſie, a knowledge of it is abſolutely required of the *geognoſt*. It makes him acquainted with the individual

* The ſynonymes I have quoted only refer to authors who have given deſcriptions of minerals.

minerals

minerals of which the great mafs of the earth is compofed, with their various relations to each other, and thus paves the way for the inveftigation of the ftructure and numerous relations of thofe greater maffes of which the cruft of the globe is conftructed. To the geognoft.

To the metallurgift. To the *metallurgist* it affords the fure means of feparating the different ores, and thus prevents the numerous errors in the proceffes of fmelting, which are fo often committed by mixing with the pure ore different foreign and pernicious ores and foffils.

To the miner. The *miner*, by an acquaintance with oryctognofie, is enabled to diftinguifh the various minerals he meets with in his fubterraneous workings from one another, and to regulate œconomically the labours of the feparating houfe, and the various operations of ftamping and wafhing.

To the mineralogical chemift. The *mineralogical chemist* cannot make us acquainted with the minerals which he has analyfed, or know thofe he is about to fubject to his operations, without a thorough knowledge of this branch of mineralogy. Its language will alfo enable him to defcribe his products and educts according to their colour, form, confiftence, texture, &c. which, although but little attended to, is unqueftionably of the greateft importance. We have only to read the defcriptions of chemical products that are ufually given to be convinced of the loofenefs of the language employed, and the neceffity of introducing into chemiftry the defcriptive language of oryctognofie.

To the œconomift. To thofe who occupy themfelves with the determination, value, and ufes of gems, ores, limeftones,

 coals,

coals, building ſtones, ſaline ſubſtances, &c. oryctognoſtic knowledge is abſolutely neceſſary; without it they will be expoſed to perpetual loſſes and diſappointments.

To the man of liberal education. *To the man of liberal education* it will afford much inſtruction and pleaſure. It will give him a very great degree of accuracy in the determination of the external aſpects of bodies, whether natural or artificial, and this preciſion he will carry into the other objects of his enquiries. Beſides this, by becoming acquainted with the materials of which the earth is compoſed, he will naturally be led to continue his reſearches in order to become acquainted with thoſe more extenſive relations of minerals which are made known to us by that ſublime branch of mineralogy *Geognoſie*.

Qualifications required of an oryctognoſt. 15. To be entitled, however, to the character of an oryctognoſt, that empyrical knowledge which we ſo often meet with will not ſuffice. To merit ſuch a name we muſt be fully acquainted with all the external characters, with the manner of employing them; we muſt have a readineſs in knowing and a preciſion in diſcriminating minerals; we muſt be able eaſily to refer known minerals to their place in the ſyſtem, and when new ſpecies or ſubſpecies occur, we muſt be able to give them their proper place in a natural arrangement, and to arrange the tranſitions in ſuch a manner that the mineral ſpecies or ſubſpecies may participate of the characters of the preceding and the following members of the ſyſtem. We muſt from well choſen ſpecimens be able to determine the nature

ture of their repofitories, and among the mountains muft be able to do the fame. We muft know the chemical properties and compofition of minerals, and all their variety of œconomical ufes, and muft know how to make, arrange, and defcribe collections, and muft be well acquainted with the hiftory of the individual fpecies, and with that of oryctognofie in general.

In fome countries mineralogy viewed as an infignificant and eafily acquired branch of knowledge.

Notwithftanding the long experience and minute attention which are required to form an accomplifhed oryctogonift, in fome countries mineralogy has been hitherto confidered as merely a trifling branch of the fcience of medicine, or of political œconomy, or claffed perhaps with the art of mending a dull fire, which every perfon conceives he underftands, whether he has given himfelf the trouble of learning it or not. The time, however, we truft, is not far diftant, when fuch pretences to fcience, the banes of true knowledge, will fink into merited contempt, and when mineralogy will be efteemed worthy of being regularly ftudied as one of the moft ufeful and interefting branches of human knowledge.

BOOKS QUOTED

IN THIS

WORK.

Titles of Books.	Abbreviations under which they are designated.
Syſtema Mineralogicum, Wallerius, 1778.	*Wall.*
Syſtema Naturæ, Linnæus, 1768.	*Lin.*
Chriſtallographie, ou Deſcription des Formes Propres a tous les Corps du Regne Mineral par M. de Romé de Liſle, 1783. 4 tom.	*Rome d. L.*
Theophraſtus's Hiſtory of Stones, with an Engliſh verſion, and notes, by Sir John Hill, 1774.	*Hill Theoph.*

Catalogue

Titles of Books.	Abreviations under which they are designated.
Catalogue Methodique et Raisonné de la Collection des Fossiles, de Mademoiselle Eleonore de Raab, Vienne, 1790.	*Born.*
Wiedenman's Mineralogie.	*Wid.*
Elements of Mineralogy, by Richard Kirwan, Esq. 1794 and 1796.	*Kirw.*
Lehrbuch der Mineralogie Entworfen von Ludwig August Emerling, 3 Bände.	*Emm.*
Reuss's Orographie des Nordwestlichen Mittelgebirges, 1790.	*Reuss. Mittelgib.*
Mineralogische Geographie von Böhmen von F. A. Reuss, 1793 and 1797. 2 Bänd. 4to.	*Reuss Böhmen.*
Versuch einer Mineralogie nach des Herrn Bergcommisionraths Werner's Methode von Abbe Estner, 3 Bände, 1794.	*Estner.*
Voyages dans les Alpes, 4 vol. in 4to. 1799 & 1796, by Saussure.	*Sauss.*
Theorie de la Terre, t. 1 & 2, par la Metherie, 1797.	*Lam.*

Traité

Titles of Books.	Abreviations under which they are designated.
Traité de Mineralogie, par Abbe Hauy, 4 tom. 1801.	*Hauy.*
Traité Elementaire de Mineralogie suivant les Principes du Professor Werner, Conseiller des Mines de Saxe, par J. A. Brochant, 2 tom. 1803.	*Broch.*

TABULAR

TABULAR VIEW

OF THE

MINERAL SYSTEM.

MINERAL SYSTEM.

CLASS I.

EARTHY FOSSILS.

ENGLISH NAMES.	GERMAN NAMES.
1. DIAMOND GENUS.	
Species.	*Gattung.*
1. DIAMOND.	Diamant.
2. ZIRCON GENUS.	
2. Zircon.	Zirkon.
3. Hyacinth.	Hyazinth.
3. FLINT GENUS.	
4. Chryſoberyll.	Khriſoberill.
5. Chryſolite.	Kriſolith.
Garnet Family.	
6. Olivine	Olivin.
7. Augite.	Augit.
8. Veſuviane.	Veſuvian.
9. Leuzite.	Leuzit.
10. Melanite.	Melanit.
11. Garnet.	Granat.
a. Precious.	a. Edler.
b. Common.	b. Gemeiner.
12. Pyrope.	Pyrop.
13. Grenatite.	Granatit.

Ruby Family.

14. Spinelle.	Spinell.
15. Sapphire.	Saphir.
16. Corundum.	Korund.
17. Diamond ſpar.	Demant ſpath.
18. Emery.	Schmiergel.

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19. Topaz.	Topas.

Schorl Family.

20. Emerald.	Schmaragd.
21. Beryll.	Berill.
a. Precious.	*a.* Edler.
b. Schorlous.	*b.* Schörlartiger.
22. Schorl.	Schörl.
a. Common.	*a.* Gemeiner.
b. Electric.	*b.* Electriſcher.

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23. Thumerſtone.	Thumerſtein.

Quartz Family.

24. Iron flint.	Eiſen kieſel.
25. Quartz.	Quarz.
a. Amethyſt.	*a.* Amethyſt.
α. Common.	*α.* Gemeiner.
β. Thick fibrous.	*β.* Dick faſriger.
b. Rock cryſtal.	*b.* Berg kriſtall.
c. Milk quartz.	*c.* Milch quarz.
d. Common quartz.	*d.* Gemeiner quarz.
e. Praſe.	*e.* Praſem.
26. Hornſtone.	Hornſtein.
a. Splintery.	*a.* Splittriger.
b. Conchoidal.	*b.* Muſchlicher.
c. Woodſtone.	*c.* Holzſtein.
27. Flint.	Feuerſtein.
28. Calcedony.	Kalzedon.
a. Common.	*a.* Gemeiner.
b. Carnelian.	*b.* Karniol.

29. Heliotrop.

29. Heliotrope.	Heliotrop.
30. Chryfoprafe.	Krifopras.
31. Plafma.	Plafma.
32. Flint flate.	Kiefelfchiefer.
a. Common.	*a.* Gemeiner.
b. Lydian ftone.	*b.* Lydifcherftein.
33. Cat's eye.	Katzenauge.

Zeolite Family.

34. Prehnite.	Prehnit.
35. Zeolite.	Zeolith.
a. Mealy.	*a.* Mehl.
b. Fibrous.	*b.* Fafriger.
c. Radiated.	*c.* Strahliger.
d. Foliated.	*d.* Blättriger.
e. Cubic.	*e.* Würfel.
36. Crofs ftone.	Kreuzftein.
37. Azure ftone.	Lazurftein.

4. CLAY GENUS.

38. Jafper.	Jafpis.
a. Egyptian.	*a.* Ægiptifher.
b. Striped.	*b.* Band.
c. Porcelain.	*c.* Porzellan.
d. Common.	*d.* Gemeiner.
α. Conchoidal.	*α.* Mufchlicher.
β. Earthy.	*β.* Erdiger.
e. Agate.	*e.* Agath.
f. Opal.	*f.* Opal.
39. Opal.	Opal.
a. Precious	*a.* Edler.
b. Common.	*b.* Gemeiner.
c. Semi.	*c.* Halb.
d. Wood.	*d.* Holz.
40. Pitchftone.	Pechftein.
41. Obfidian.	Obfidian.

42. Pearlftone.

42. Pearlſtone.	Perlſtein.
43. Pumice.	Bimſtein.
44. Feldſpar.	Feldſpath.
a. Compact.	*a.* Dichter.
b. Common.	*b.* Gemeiner.
α. Freſh.	*α.* Friſcher.
β. Diſintegrated.	*β.* Aufgelöſter.
c. Adularia.	*c.* Adular.
d. Labradorſtone.	*d.* Labradorſtein.
45. Pure clay.	Reine thonerde.
46. Procelain clay.	Porzellanerde.
47. Common clay.	Töpfer thon.
a. Loam.	*a.* Leim.
b. Pipe clay.	*b.* Pfeiffen thon.
c. Potter's clay.	*c.* Töpfer thon.
d. Variegated clay.	*d.* Bunter thon.
e. Clayſtone.	*e.* Thonſtein.
f. Slate clay.	*f.* Schiefer thon.
48. Poliſhing or polier ſlate.	Polierſchiefer.
49. Tripoli.	Trippel.
50. Alum ſtone.	Alaunſtein.
51. Alum earth.	Alaun erde.

Slate Family.

52. Alum ſlate.	Alaunſchiefer.
a. Common.	*a.* Gemeiner.
b. Gloſſy.	*b.* Glänzender.
53. Bituminous ſhale.	Brandſchiefer.
54. Drawing ſlate.	Zeichenſchiefer.
55. Whet ſlate.	Wetzſchiefer.
56. Clay ſlate.	Thonſchiefer.

Mica Family.

57. Lepidolite.	Lepidolith.
58. Mica, or Glimmer.	Glimmer.
59. Potſtone.	Topfstein.

60. Chlorite.

60. Chlorite.	Chlorit.
a. Chlorite earth.	*a.* Chlorit erde.
b. Common chlorite.	*b.* Gemeiner chlorit.
c. Chlorite ſlate.	*c.* Chloritſchiefer.
d. Foliated chlorite.	*d.* Blättriger chlorit.

Trap Family.

61. Hornblende.	Hornblende.
a. Common.	*a.* Gemeiner.
b. Labrador.	*b.* Labradoriſche.
c. Baſaltic.	*c.* Baſaltiſche.
d. Hornblende ſlate.	*d.* Hornblendſchiefer.
62. Baſalt.	Baſalt.
63. Wacce, or Wacke.	Wakke.
64. Clinkſtone.	Klingſtein.

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65. Lava.	Lava.

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66. Greenearth.	Grünerde.

Lithomarge Family.

67. Lithomarge.	Steinmark.
a. Friable.	*a.* Zerreibliches.
b. Indurated.	*b.* Verhärtetes.
68. Rock ſoap.	Bergſeife.
69. Yellow earth.	Gelberde.

5. TALC GENUS.

Soapſtone Family.

70. Bole.	Bol.
71. Native talc earth.	Natürliche talkerde.
72. Meerſchaum.	Meerſchaum.
73. Fullers earth.	Walkerde.

Talc Family.

74. Nephrite.	Nephrit.
a. Common.	*a.* Gemeiner.
b. Axeſtone.	*b.* Beilſtein.

75. Steatite.	Speckſtein.
76. Serpentine.	Serpentin.
a. Common.	a. Gemeiner.
b. Precious.	b. Edler.
α. Conchoidal.	α. Muſchlicher.
β. Splintery.	β. Splittriger.
77. Schillerſtone.	Schillerſtein.
78. Talc.	Talk.
a. Earthy.	a. Erdiger.
b. Common.	b. Gemeiner.
c. Indurated.	c. Verhærteter.
79. Aſbeſt.	Aſbeſt.
a. Rock cork.	a. Berg kork.
b. Amianth.	b. Amiant.
c. Common aſbeſt.	c. Gemeiner Aſbeſt.
d. Rock wood.	d. Bergholz.

Actynolite Family.

80. Kyanite.	Cianit.
81. Actynolite.	Strahlſtein.
a. Aſbeſtous.	a. Aſbeſtartiger.
b. Common.	b. Gemeiner.
c. Glaſſy.	c. Glaſiger.
82. Tremolite.	Tremolith.
a. Aſbeſtous.	a. Aſbeſtartiger.
b. Common.	b. Gemeiner.
c. Glaſſy.	c. Glaſiger.

6. Calc Genus.

83. Rock milk.	Berg milch.
84. Chalk.	Kreide.
*85. Limeſtone.	Kalkſtein.
a. Compact.	a. Dichter.
α. Common compact.	α. Gemeiner dichter.
β. Roeſtone.	β. Rogenſtein.

b. Foliated

b. Foliated limeſtone.	*b*. Blättriger kalkſtein.
α. Granular.	*α*. Körniger.
β. Calc ſpar.	*β*. Kalkſpath.
c. Fibrous limeſtone.	*c*. Faſriger kalkſtein.
α. Common.	*α*. Gemeiner.
β. Calc ſinter.	*β*. Kalkſinter.
d. Peaſtone.	*d*. Erbſenſtein.
85. Schaum earth, or calc ſhaum.	Schaumerde.
86. Slate ſpar, or ſhiver ſpar.	Schieferſpath.
87. Brown ſpar.	Braunſpath.
88. Rhomb ſpar.	Rautenſpath.
89. Schalſtone.	Schaalſtein.
90. Stink ſtone.	Stinkſtein.
91. Marle.	Mergel.
a. Marle earth.	*a*. Mergelerde.
b. Indurated marle.	*b*. Verhärteter.
92. Bituminous marl ſlate.	Bituminöſer mergelſchiefer.
93. Calctuf.	Kalktuff.
94. Arragone.	Arragon.
95. Appatite.	Apatit.
96. Spargel ſtone, or Aſparagus ſtone.	Spargelſtein.
97. Boracite.	Borazit.
98. Fluor.	Fluſs.
a. Compact.	*a*. Dichter.
b. Fluor ſpar.	*b*. Fluſſpath.
99. Gyps.	Gips.
a. Gyps earth.	*a*. Gipſerde.
b. Compact.	*b*. Dichter.
c. Foliated.	*c*. Blättriger.
d. Fibrous.	*d*. Faſriger.
100. Selenite.	Fraueneis.
101. Cube ſpar.	Würfelſpath.

7. Baryte Genus.

102. Witherite.	Witherit.
103. Baryte.	Schwerſpath.
a. Baryte earth.	*a.* Schwerſpatherde.
b. Compact baryte.	*b.* Dichter.
c. Granular.	*c.* Körniger.
d. Curved lamellar.	*d.* Krumm ſchaaliger.
e. Straight lamellar.	*e.* Gerad ſchaaliger.
α. Freſh.	α. Friſcher.
β. Diſintegrated.	β. Mulmicher.
f. Columnar ſpar.	*f.* Stangenſpath.
g. Priſmatic baryte.	*g.* Saülen ſchwerſpath.
h. Bologneſe ſpar.	*h.* Bologneſer ſpath.

8. Strontiane Genus.

104. Strontiane.	Stronthian.
105. Celeſtine.	Celeſtin.
a. Fibrous.	*a.* Faſriger.
b. Foliated.	*b.* Blättriger.

CLASS II.

FOSSIL SALTS.

106. Natural ſoda.	Natürliches mineral alkali.
107. Natural nitre.	Natürliches ſalpeter.
108. Natural rock ſalt.	Natürliches kochſalz.
a. Stone ſalt.	*a.* Steinſalz.
α. Foliated	α. Blättriges.
β. Fibrous.	β. Faſriges.
b. Sea ſalt.	*b.* See ſalz.
109. Natural ſal ammoniac.	Natürlicher ſalmiak.
110. Natural vitriol.	Natürlicher vitriol.
111. Hair ſalt.	Haarſalz.

112.	Rock butter.	Bergbutter.
113.	Natural Epfom falt.	Natürliches Bitterfalz.
114.	Natural Glauber falt.	Natürliches Glauberfalz.

CLASS III.

INFLAMMABLE FOSSILS.

1. Sulphur Genus.

115.	Natural fulphur.	Natürlicher fchwefel.
	a. Common.	*a.* Gemeiner.
	b. Volcanic.	*b.* Vulcanifcher.

2. Bituminous Genus.

116.	Bituminous wood.	Bituminöfes Holz.
	a. Common.	*a.* Gemeines.
	b. Bituminous wood earth.	*b.* Erdkohle.
117.	Coal.	Steinkohle.
	a. Brown coal.	*a.* Braunkohle.
	b. Moor coal.	*b.* Moorkohle.
	c. Pitch coal.	*c.* Pechkohle.
	d. Glance coal.	*d.* Glanzkohle.
	e. Columnar coal.	*e.* Stangenkohle.
	f. Slate coal.	*f.* Schieferkohle.
	g. Cannel coal.	*g.* Kannelkohle.
	h. Foliated coal.	*h.* Blätterkohle.
	i. Coarfe coal.	*i.* Grobkohle.
118.	Mineral charcoal.	Mineralifches holzkohle.
119.	Foffil oil.	Erdöl.
120.	Mineral pitch.	Erdpech.
	a. Elaftic.	*a.* Elaftifches.
	b. Earthy.	*b.* Erdiges.
	c. Slaggy.	*c.* Schlackiges.

121. Amber.	Bernſtein.
a. White.	*a.* Weiſſer.
b. Yellow.	*b.* Gelber.
122. Honey ſtone.	Honigſtein.

3. Graphite Genus.

123. Graphite.	Graphit.
a. Scaly.	*a* Schuppiger.
b. Compact.	*b.* Dichter.
124. Coalblende.	Kohlenblende.

CLASS IV.

METALLIC FOSSILS.

1. Platina Genus.

125. Native platina.	Gediegen platin.

2. Gold Genus.

126. Native gold.	Gediegen gold.
a. Gold yellow.	*a.* Goldgelbes.
b. Braſs yellow.	*b.* Meſſingelbes.
c. Greyiſh yellow.	*c.* Graugelbes.

3. Quicksilver Genus.

127. Native quickſilver.	Gediegen queckſilber.
128. Natural amalgam.	Natürliches amalgam.
a. Fluid.	*a.* Flüſſiges.
b. Solid.	*b.* Feſtes.
129. Quickſilver horn ore.	Queckſilber hornerz.
130. Quickſilver liver ore.	Queckſilber lebererz.
a. Compact.	*a.* Dichtes.
b. Slaty.	*b.* Schiefriges.
131. Cinnober.	Zinnober.
a. Dark red.	*a.* Dunkel rother.
b. Bright red.	*b.* Hoch rother.

4. Silver

4. SILVER GENUS.

132. Native filver.	Gediegen filber.
a. Common.	*a.* Gemeines.
b. Goldifh.	*b.* Giltiges.
133. Antimonial filver.	Spiefglas filber.
134. Arfenic filver.	Arfenik filber.
135. Horn ore.	Hornerz.
136. Silver black.	Silberfchwärtze.
137. Silver glance.	Glaferz.
138. Brittle filver glance.	Spröd glaferz.
139. Red filver ore.	Roth giltig erz.
a. Dark.	*a.* Dunkles.
b. Light.	*b.* Lichtes.
140. White filver ore.	Weiffgiltig erz.
141. Black filver ore.	Schwartz giltig erz.

5. COPPER GENUS.

142. Native copper.	Gediegen kupfer.
143. Copper glance.	Kupferglas.
a. Compact.	*a.* Dichtes.
b. Foliated.	*b.* Blättriges.
144. Variegated copper ore.	Bunt kupfererz.
145. Copper pyrites	Kupferkies.
146. White copper ore.	Weifs kupfererz.
147. Fahl ore.	Fahlerz.
148. Copper black.	Kupfer fchwärtze.
149. Red copper ore.	Roth kupfererz.
a. Compact.	*a.* Dichtes.
b. Foliated.	*b.* Blattriges.
c. Capillary.	*c.* Haarförmiges.
150. Tile ore.	Ziegelerz.
a. Earthy.	*a.* Erdiges.
b. Indurated.	*b.* Verhärtetes.
151. Copper azure.	Kupferlafur.
a. Earthy.	*a.* Erdige.
b. Radiated.	*b.* Strahlige.

152. Malachite.

152. Malachite.	Malachit.
a. Fibrous.	*a*. Fasriger.
b. Compact.	*b*. Dichter.
153. Copper green.	Kupfergrün.
154. Iron shot copper green.	Eisenschüssiges kupfergrün.
a. Earthy.	*a*. Erdiges.
b. Slaggy.	*b*. Schlackiges.
155. Oliven ore.	Olivenerz.
156. Copper mica.	Kupferglimmer.
157. Copper emerald.	Kupferschmaragd.

6, Iron Genus.

158. Native iron.	Gediegen eisen.
159. Iron pyrites.	Schwefel kies.
a. Common.	*a*. Gemeiner.
b. Radiated.	*b*. Strahlkies.
c. Liver pyrites.	*c*. Leberkies.
d. Hair pyrites.	*d*. Haarkies.
160. Magnetic pyrites.	Magnetkies.
161. Magnetic iron stone.	Magnet eisenstein.
a. Compact.	*b*. Gemeiner.
b. Iron sand.	*b*. Eisen sand.
162. Iron glance.	Eisenglanz.
a. Common.	*a*. Gemeiner.
α. Compact.	*α*. Dichter.
β. Foliated.	*β*. Blättriger.
b. Iron glimmer, or iron mica.	*b*. Eisenglimmer.
163. Red iron stone.	Roth eisenstein.
a. Red iron froth.	*a*. Rother eisenrahm.
b. Ochry red iron stone.	*b*. Ockriger rotheisenstein.
c. Compact.	*c*. Dichter.
d. Red hematite.	*d*. Rother glaskopf.
164. Brown iron stone.	Braun eisenstein.

a. Brown

a. Brown iron froth.	*a*. Brauner eifenrahm.
b. Ochry brown iron ftone.	*b*. Ockriger brauneifen-ftein.
c. Compact.	*c*. Dichter.
d. Brown hematite.	*d*. Brauner glafkopf.
165. Sparry iron ftone.	Spath eifenftein.
166. Black iron ftone.	Schwartz eifenftein.
a. Compact.	*a*. Dichter.
b. Black hematite.	*b*. Schwarzer glafkopf.
167. Clay iron ftone.	Thon eifenftein.
a. Reddle.	*a*. Röthel.
b. Columnar clay iron ftone.	*b*. Stänglicher thon eifen-ftein.
c. Lenticular clay iron ftone.	*c*. Linfenförmiges thon eifenftein.
d. Jafpery clay iron ftone.	*d*. Jafpifartiges thon eifen-ftein.
e. Common clay iron ftone.	*e*. Gemeiner thon eifen-ftein.
f. Iron kidney.	*f*. Eifenniere.
g. Pea ore.	*g*. Bohnerz.
168. Bog iron ore.	Rafen eifenftein.
a. Morafs ore.	*a*. Moraftерz.
b. Swamp ore.	*b*. Sumpferz.
c. Meadow ore.	*c*. Wiefenerz.
169. Blue iron earth.	Blaue eifenerde.
170. Green iron earth.	Grüne eifenerde.

7. Lead Genus.

171. Lead glance.	Bleiglanz.
a. Common.	*a*. Gemeiner.
b. Compact.	*b*. Bleifchweif.
172. Blue lead ore.	Blau bleierz.
173. Brown lead ore.	Braun bleierz.
174. Black lead ore.	Schwarz bleierz.

175. White

175.	White lead ore.	Weis bleierz.
176.	Green lead ore.	Grün bleierz.
177.	Red lead ore.	Roth bleierz.
178.	Yellow lead ore.	Gelb bleierz.
179.	Natural lead vitriol.	Natürlicher bleivitriol.
180.	Lead earth.	Bleierde.
	a. Coherent.	*a.* Feſte.
	b. Friable.	*b.* Zerreibliche.

8. Tin Genus.

181.	Tin pyrites.	Zinnkies.
182.	Tin ſtone.	Zinnſtein.
183.	Corniſh tin ore.	Korniſch zinnerz.

9. Bismuth Genus.

184.	Native biſmuth.	Gediegen wiſmuth.
185.	Biſmuth glance.	Wiſmuthglanz.
186.	Biſmuth ochre.	Wiſmuthocker.

10. Zinc Genus.

187.	Blende.	Blende.
	a. Yellow.	*a.* Gelbe.
	b. Brown.	*b.* Braune.
	c. Black.	*c.* Schwarze.
188.	Calamine.	Galmei.

11. Antimony Genus.

189.	Native antimony.	Gediegen ſpieſglas.
190.	Grey antimony.	Grau ſpieſglas.
	a. Compact.	*a.* Dichtes.
	b. Foliated.	*b.* Blättriges.
	c. Radiated.	*c.* Strahliges.
	d. Featheroſe.	*d.* Federerz.
191.	Red antimony.	Roth ſpieſglaſerz.
192.	White antimony.	Weiſs ſpieſglaſerz.
193.	Antimony ochre.	Spieſglas oker.

12. Cobalt Genus.

194. White cobalt ore. — Weiffer fpeiffcobalt.
195. Grey cobalt ore. — Grauer fpeiffcobalt.
196. Cobalt glance. — Glanz kobalt.
197. Black cobalt ochre. — Schwarzer erdkobalt.
  a. Earthy. — *a.* Schwartzer kobalt mulm.
  b. Indurated. — *b.* Fefter fchwarzer erdkobalt.
198. Brown cobalt ochre. — Brauner erdkobalt.
199. Yellow cobalt ochre. — Gelber erdkobalt.
200. Red cobalt ochre. — Rother erdkobalt.
  a. Cobalt cruft. — *a.* Kobalt befchlag.
  b. Cobalt bloom. — *b.* Kobalt blüthe.

13. Nickel Genus.

201. Kupfer nickel. — Kupfernickel.
202. Nickel ochre. — Nickel ocker.

14. Manganese Genus.

203. Grey mangauefe ore. — Grau braunfteinerz.
  a. Radiated. — *a.* Strahliges.
  b. Foliated. — *b.* Blättriges.
  c. Compact. — *c.* Dichtes.
  d. Earthy. — *d.* Erdiges.
204. Black manganefe ore. — Schwarz Braunfteinerz.
205. Red manganefe ore. — Roth Braunfteinerz.

15. Molybdane Genus.

206. Molybdane. — Wafferblei.

16. Arsenic Genus.

207. Native arfenic. — Gediegen arfenic.
208. Arfenical pyrites. — Arfenikkies.
  a. Common. — *a.* Gemeiner.
  b. Silverifh. — *b.* Weiferz.

209. Orpiment.	Raufchgelb.
a. Yellow.	*a.* Gelbes raufchgelb.
b. Red.	*b.* Rothes raufchgelb.

17. Scheele Genus.

210. Tungften.	Schwerftein.
211. Wolfram.	Wolfram.

18. Menac Genus.

212. Menacan.	Menakan.
213. Rutile.	Rutil.
214. Nigrine.	Nigrin.
215. Iferine.	Iferin.

19. Uran Genus.

216. Pitch ore.	Pecherz.
217. Uran mica.	Uranglimmer.
218. Uran ochre.	Uranocker.

20. Sylvan Genus.

219. Native fylvan.	Gediegen fylvan.
220. Graphic fylvan ore.	Schrifterz.
221. Yellow fylvan ore.	Weifs fylvanerz.
222. Black fylvan ore.	Nagiakererz.

MINERAL SYSTEM.

WENN irgend eine Wiſſenſchaft, die ihren vereher auszeichnen ſoll, den muth des enthuſiaſmus und das ertragen von mühe und beſchwerlichkeiten erfordert, ſo iſt es der Mineralogie. Der Theolog, der Juriſt, der Philoſoph, der ſchöne Geiſt kann ein groſſer Mann auf ſeinem ſtudierzimmer werden, der Aſtronom vom obſervatorium die Kreiſe der Welten beobachten, und ſich einen unſterblichen namen erwerben. Nicht ſo der Mineralog und Naturforſcher. Die Natur mit ihren vielen Merkwürdigkeiten, und Geheimniſſen, will ſelbſt betrachtet ſeyn. Ihr Dienſt iſt der mühſamſte, ſo wie ihre Kenntniſs die reizendſte und angenehmſte. Auch hat die Göttin keiner Wiſſenſchaft eifrigere Liebhaber, keine ſo viele, die die märtyrer ihrer ergebenheit und ſtudiums geworden ſind.

MINERAL SYSTEM.

CLASS I.

EARTHY FOSSILS.

FIRST GENUS.

DIAMOND GENUS.

Diamond.

Demant, or Diamant.—*Werner*.

Alumen lapidosum pellucidissimum hyalinum, *Lin.*—Gemma vera colore aqueo, *Cartheus.*—Quartzum nobile, *Born.*—Diamond, *Kirw.* vol. 1. p. 393.—Diamant, *Estner*. b. 2. s. 54. *Ibid. Emm.* b. 1. s. 187.—Le Diamant, *Broch.* t. 1. p. 153. *Ibid. Hauy Min.* t. 3. p. 287.

External Characters.

THE most common colours of the Diamond are white and grey. The varieties of white are snow white, greyish white, and yellowish white; of grey, ash grey, smoke grey, blueish grey, pearl grey, yellowish and greenish grey.

Besides

Beſides theſe two colours, it occurs blue, red, brown, yellow, and green.

Of the blue the only variety which Werner poſſeſſes is indigo blue: it probably paſſes into red.

Of red it occurs roſe red and cherry red; from the latter it paſſes into clove brown and yellowiſh brown; from this into ochre yellow, wine yellow, lemon and ſulphur yellow: further into ſiſkin green, aſparagus green, piſtachio green, leek green, and laſtly into mountain green: which latter probably paſſes into greeniſh grey.

The clove brown ſometimes approaches to black. The indigo blue and the red are the rareſt varieties. The ſnow white is the moſt highly valued, and the grey, and ſtill more the brown, are the leaſt valued.

The colours are moſt generally pale and light, ſeldom deep, and far ſeldomer dark.

It exhibits a moſt beautiful play of colours.

It occurs in indeterminately angular and completely ſpherical grains, which ſometimes preſent planes of cryſtallization: it alſo occurs cryſtallized.

Its fundamental cryſtal is the octaedron, which paſſes on the one ſide,

1ſt, Into the ſimple three-ſided pyramid, with truncated angles, and probably alſo into the ſix ſided table, in which the terminal planes are ſet alternately oblique and ſtraight on the lateral planes.

2d, On the other ſide it divides itſelf into three branches.

a. Octaedron.

a. Octaedron with bevilled edges, the bevilling planes cylindrically convex.

b. Octaedron with once broken bevilled edges.

c. Octaedron with truncated edges, and the truncating planes cylindrically convex.

When the bevilling planes of *a* become fo large as to caufe the planes of the octaedron to difappear, an octaedron is formed in which each plane is divided into three, and the dividing edge runs from the middle point to the angles.

When the planes of *b* increafe in the fame proportion, every plane of the octaedron becomes divided into fix, fo that three edges run from the middle point to the middle of the lateral edges, and three to the angles of the octaedron.

When the truncating planes of *c* increafe fo much as to caufe the original ones to difappear, the garnet dodecaedron with cylindrical convex lateral planes is formed. Of this figure the following varieties and twin cryftals occur.

1. When the planes of the acuminations very nearly touch each other, a double three-fided pyramid is formed.
2. Garnet dodecaedron with divided planes; in this figure each plane is divided into two, and the dividing edge paffes through the obtufe angle of the rhomb.
3. If two cryftals refembling the preceding, but with undivided planes, are turned around a fixth of their periphery, and pufhed into each other, a very flat three-fided pyramid is formed,

formed, in which the lateral planes of the one are ſet on the lateral planes of the other, and the remains of the priſms form four-planed acuminations on the angles of the common baſe.

4. If two garnet dodecaedrons, with divided planes, are turned around a ſixth of their periphery, and puſhed into each other, a very ſhort ſix-ſided priſm is formed, which is deeply and flatly acuminated on both extremities by ſix planes, which are ſet on the lateral planes.

5. When the priſm of four diſappears a double ſix-ſided pyramid is formed.

The cryſtals are ſmall and very ſmall, ſeldom middle ſized, and very rarely large.

The ſurface in the octaedron is ſmooth, alſo ſtreaked; that of the grains uneven, granulated, alſo ſometimes approaching to druſy, and frequently rough.

Externally its luſtre alternates from ſplendent to glimmering; internally it is always ſplendent, even often ſpecularly ſplendent, and adamantine.

The fracture is ſtraight and perfectly foliated with a fourfold equiangular cleavage, and the cleavages are parallel with the ſides of the octaedron.

The fragments are octaedral, or in the figure of a tetraedral pyramid.

It is commonly unſeparated, *(unabgeſondert)* yet it ſometimes very rarely occurs in ſmall and fine-grained diſtinct concretions.

Commonly

Commonly it is not completely tranſparent; in moſt caſes it rather inclines to ſemitranſparent.

Hard in the higheſt degree.

Brittle.

Not particularly difficultly frangible.

Not particularly heavy; approaching heavy.

Specific gravity—3,600, *Werner*—3,400, *Wallerius*—3,500, *Cronſtedt*—3,518, *Muſchenbroeck*—3,521, *Briſſon*—3,666, *Muſchenbroeck*, yellow braſilian.

Conſtituent Parts.

Boece de Boot, in his Hiſtory of Gems, publiſhed in 1609, conjectured that the diamond was an inflammable ſubſtance. In 1673 Mr Boyle diſcovered, that when expoſed to a high temperature, part of it was diſſipated in acrid vapours. In 1694 and 1695 a ſeries of experiments was made in preſence of the Grand Duke of Tuſcany, which confirmed thoſe of Mr Boyle, and ſhewed, that the diamond, although the hardeſt of foſſils, agreed with combuſtible bodies in being combuſtible. In 1704 Sir Iſaac Newton, in his great work on Optics, hinted, that from its very great refracting power, it might be an unctuous ſubſtance coagulated *. The experiments of Darcet,

* Newton does not appear to have been acquainted with the experiments made in Tuſcany; and beſides, a conſiderable part of his work on Optics was written in 1675.

Lavoiſier, Tennant, Lampadius, and Morveau, have demonſtrated that it is nearly pure carbone.

Chemical Characters.

Begins to burn at a temperature not exceeding 14° or 15° of Wedgewood *.

Phyſical Characters.

It ſhews ſigns of poſitive electricity by rubbing; and it is ſaid to ſhine in the dark, after having been expoſed for ſome time to the rays of the ſun. This latter property is denied by Werner, who affirms that he repeatedly made the experiment, but without ſucceſs.

Geognostic Situation.

It is found ſometimes looſe in ſand, ſometimes incloſed in a loamy earth. Its original repoſitory *(lagerstätte)* is ſtill imperfectly known. Werner ſuſpects that it occurs, like hyacinth, zircon, pyrope and ſpinelle, imbedded in rocks belonging to the neweſt floetz trap formation.

* Nicholſon's Journal, v. 104.

Geographic

Geographic Situation.

It is found in India and South America. In India it occurs chiefly in the provinces of Golconda, Vifa-pour, and at the foot of the Orixa mountains in Bengal. It is faid to have been found in the peninfula of Malacca and the ifland of Borneo. In South America it has hitherto been only found in the diftrict of Serra Dofrio, in Brazil.

Ufe.

The ufes of diamond in jewellery, and for cutting hard foffils are well known : the detail refpecting the different modes of cutting, polifhing, and valuing, will be given in that part of this work which treats of Oeconomical Mineralogy.

SECOND GENUS.

ZIRCON GENUS.

FIRST SPECIES.

Zircon.

Zirkon.—*Werner.*

Topazius clarus hyalinus jargon, *Wall,* t. 1. p. 252.—Jargon de Ceylan, *Rome de L.* t. 1. p. 229. *Id. Born.* t. 1. p. 77.—Zirkon, *Wid.* ſ. 233. *Id. Kirw.* vol. 1. p. 257. *Id. Eſtner.* b. 2. ſ. 35. *Id. Emm.* b. 1. ſ. 3. —Giargone, *Nap.* p. 105.—Zircon, *Lam.* t. 2. p. 204. *Id. Broch.* t. 1. p. 159. *Id. Hauy.* t. 2. p. 465.

External Characters.

Its chief colour is grey; but it occurs alſo green, blue, red, yellow, and brown.

The varieties of grey are greeniſh, yellowiſh, aſh, and ſmoke grey; ſometimes it approaches to blueiſh grey. The ſmoke and aſh grey varieties, when pale, approach to white.

The yellowiſh grey ſometimes paſſes into yellow.

The green paſſes into oil-olive, and into an intermediate colour between piſtachio and leek green, and even into graſs green. From the olive green it paſſes into broccoli brown, (which is characteriſtic

charaƈteriſtic of zircon), from this into plumb blue, and columbine red; and laſtly into yellowiſh and reddiſh brown.

The colours are ſometimes dark, ſometimes very dark, and alſo light; and from their falling more or leſs into grey are always a little muddy.

It occurs moſt commonly in roundiſh angular pieces, which have almoſt always rounded angles and edges. Alſo cryſtallized; the figures of its cryſtals are as follows:

1. A reƈtangular four-ſided priſm ſomewhat flatly acuminated by four planes, which are ſet on the lateral planes.

   Of this figure the following varieties occur:

   1. The lateral edges truncated.
   2. The angles formed by the acuminating and lateral planes bevilled; when theſe increaſe,
   3. Very acute eight planed acumination is formed.

2. A very flat oƈtaedron which is formed by the meeting of the two acuminations. It is either perfeƈt, or the edges or angles on the common baſis are truncated.

The cryſtals are almoſt always ſmall and very ſmall, very ſeldom middle ſized, and ſtill ſeldomer large. They are all around cryſtallized *(um und um crystallisirt)*, conſequently have been formed imbedded.

Surface of the cryſtals generally ſmooth, and, when it has been well preſerved, is ſhining, bordering on ſtrongly ſplendent; that of the angular pieces is

ſometimes

ſometimes uneven and ſometimes rough, and is gliſtening.

Internally its luſtre is ſtrongly ſplendent, and reſinous, paſſing into adamantine.

Fracture perfectly ſmall conchoidal.

Fragments indeterminately angular, ſharp-edged.

It is intermediate between tranſparent and ſemitranſparent, and approaches ſometimes more to the one, ſometimes more to the other, and is duplicating tranſparent *.

Hard in a high degree, very little affected by the file †.

Brittle.

Not particularly difficultly frangible.

Heavy.

Specific gravity—4,700, *Werner.*—4,615, *Klaproth.*—4,6666, *Karſten.*

Constituent Parts.

Zirconia,	69,0
Silica	26,50
Oxyd of iron,	0,50
	96,0

Klaproth, b. I. ſ. 222.

* Hauy.
† Eſtner.

Chemical Characters.

It is infufible without addition by the blow pipe: with borax it forms a colourlefs tranfparent glafs.

Geognostic Situation.

The manner of its occurrence has not as yet been fatisfactorily afcertained. Werner, from its granular external fhape, and the nature of the country where it is found, fufpects that it occurs imbedded in rocks belonging to the neweft floetz trap formation.

Geographic Situation.

In the ifland of Ceylon, where it was firft difcovered, it is found in the fand of a river, accompanied by cryftals of fpinelle, tourmaline, ceylanite, &c. and Kammerrath Von Schlotheim and Brochant inform us that it has been lately found at Friedrichfchwärn in Norway, imbedded in a rock compofed of hornblende and felfpar *.

* Probably floetz greenftone.

Ufe.

Ufe.

It is frequently cut as a precious ftone, and employed for various purpofes, but particularly as an ornament in mourning drefs. When it is cut it exhibits in a faint degree the play of colours of the diamond; and fuch varieties are not unfrequently fold as inferior kinds of diamond, and ufed by watch-makers in jewelling watches.

Obfervations.

On account of its great hardnefs and confiderable fire, fome of the older mineralogifts believed it to be a variety of diamond; and others, from its colours, have placed it fucceffively with topaz, fapphire, and ruby. The fagacious Romé de Lifle, however, fufpected that it was effentially different from all thefe ftones; and Werner, by an accurate examination of its external characters, referred it to its prefent place in the fyftem.

SECOND SPECIES.

Hyacinth.

Hiacinth.—*Werner.*

Lyncurius veterum Hill. Theophr. 127.—Topazius flave rubens, hyacinthus, *Wall.* t. 1. p. 252.—Hyacinthe, *Bruckman, Abhandl. v. d. Edelſt.* ſ. 109. *Rome d. L.* t. 2. p. 281. *Deſſen Beiträge hierzu,* ſ. 65. *Born.* t. 2. ſ. 77. *Wid.* ſ. 254. *Kirw.* vol. 1. p. 257. *Eſtner.* b. 2. ſ. 141. *Reuſs's Mittelgebirge,* ſ. 147. *Emm.* b. 1. ſ. 205. Giacinto, *Nap.* p. 109.—L'Hyacinthe, *Broch.* t. 1. p. 163.

External Characters.

Its chief colour is hyacinth red, which paſſes on the one ſide into reddiſh brown, on the other into orange yellow. From the reddiſh brown it paſſes into pale blood red, fleſh red, pearl grey, reddiſh and greyiſh white; and from the pearl grey into blueiſh grey, ſmoke grey, and yellowiſh grey. From the orange yellow it paſſes into greeniſh grey and greeniſh white. The white and grey varieties are the rareſt. It occurs in grains, and alſo cryſtallized. The cryſtals are,

The rectangular four-ſided priſm, flatly (more acute than the zircon) acuminated by four planes, which are ſet on the lateral edges.

 Of

Of this figure the following varieties occur:

1. The lateral edges truncated: when these truncations increafe,
2. The zircon cryftal is formed.
3. When the prifm becomes lower and lower and the acuminations approach fo near that they touch each other in a point, the garnet dodecaedron is formed.
4. The garnet dodecaedron fometimes paffes into a very flat octaedron. This is the rareft figure.

The cryftals are fmall, feldom middle fized, and very rarely large.

They are always imbedded.

The lateral planes are always fmooth, and externally fhining.

Internally it is fplendent; and vitreous, inclining a little to refinous.

Its fracture is perfectly ftraight foliated, twofold cleavage. The folia crofs each other rectangularly in the direction of the diagonal, fo that they interfect each other in the line of the axis of the prifm.

The fragments are indeterminately angular, fharp edged.

It is tranfparent paffing into tranflucent, and is duplicating tranfparent *.

Very hard; fcratches quartz †.

* Hauy.

† Hauy.

Not

Not particularly difficultly frangible.

Feels a little greafy when cut.

Not particularly heavy, paffing to heavy.

Specific gravity—4,0000, *Karften*—4,545 and 4,620, *Klaproth*—4,386, *Hauy*.

Constituent Parts.

	Hyacinth of Ceylon.	Hyacinth of Expailly.	
Zirconia	70	64,5	66,0
Silica	25	32,0	31,0
Oxyd of iron	0,50	2,0	2,0
Lofs	4,50	1,5	1,0
	100,	100,	100,
	Klaproth, b. 1. f. 231.	*Vauquelin*, (J. d. M. N. 26. p. 106.)	

Chemical Characters.

Expofed to the blow pipe it lofes its colour, but not its tranfparency. It is infufible, excepting with borax, which converts it into a white tranfparent glafs. *Vauquelin*. Expofed to a ftream of oxygen gas it melts into a greyifh white glafs bead. *Lampadius*.

Geognostic Situation.

In Bohemia it is found in rocks belonging to the neweſt floetz trap formation (probably Wacce); and in Ceylon it occurs in ſand, accompanied with ſpinelle ſapphire, oriental ruby, zircon, tourmaline, ceylanite, and iron ſand, according to the obſervations of the Count de Bournon.

Geographic Situation.

The Iſland of Ceylon, which is ſo remarkable for the variety of gems which it affords, is the principal place of occurence of hyacinth. It is found alſo in Spain, near Liſbon in Portugal, in the rivulet Expailly in Auvergne in France, in Italy, and at Meronitz and Hohenſtein in Saxony; probably alſo at the Ely in Fifeſhire in Scotland.

Uſe.

It takes a fine poliſh, and when it is pure (particularly the red and yellow) is very much prized: it is however very often veſicular, which diminiſhes its value and beauty.

Obſervations.

Obſervations.

The hyacinth of Werner is the lyncurium of the ancients; and the amethyſt of modern writers appears to be their hyacinth.

THIRD GENUS.

FLINT GENUS.

FIRST SPECIES.

Chryfoberyll.

Krifoberill.—*Werner.*

Chryfolithus colores reflectens varios, chryfoberyllus, *Wall*, t. 1. p. 256.—Krifoberil, *Wid.* f. 246.—*Ibid. Kirw.* vol. 1. p. 261. *Eftner*, b. 2. f 63. *Ibid. Emm.* b. 1. f. 19. Crifoberillo.—*Nap.* p. 134.—Chryfopal, *Lam.* t. 2. p. 244.—Le Chryfoberil, *Broch.* t. 1. p. 167.—Cymophane, *Hauy.* t. 2. p. 491.

External Characters.

Its chief colour is afparagus green; it paffes on the one fide into apple green, mountain green, and greenifh white; on the other fide it paffes through light olive and oil green into light yellowifh grey, which inclines ftrongly to brown, and even paffes to reddifh brown.

It exhibits a milk white light *(ſchein)*, which is very characteriſtic; when this light inclines much to blue, it is ſaid to opaleſce.

It occurs in roundiſh and angular grains, which ſometimes approach in ſhape to the cube, and which have generally worn (obſolete) edges; alſo in rolled pieces. It occurs but ſeldom cryſtalliſed. The following are its cryſtalline figures:

1. Longiſh thick ſix-ſided table, having truncated lateral edges, and longitudinally ſtreaked lateral planes.
2. When the truncating planes increaſe, the table paſſes into a double ſix-ſided pyramid, in which the ſummits of the acuminations are ſometimes truncated.

The cryſtals are ſmall.

The ſurface of the grains is intermediate between rough and ſmooth, and is gliſtening.

The cryſtals are externally ſhining, internally ſplendent, and intermediate between reſinous and vitreous, but more approaching the firſt.

Its fracture is perfectly conchoidal.

Fragments indeterminately angular and ſharp edged.

Semitranſparent and faintly tranſparent.

Hard; ſcratches quartz *.

Brittle.

Not particularly eaſily frangible.

Not particularly heavy, approaching heavy.

Specific gravity—3,600, 3,720, *Werner.*—3,710, *Klaproth.*—3,7961, *Hauy.*

* Hauy.

Constituent

Constituent Parts.

Alumina	71,5
Silica	18,0
Lime	6,0
Oxyd of iron	1,5
Loſs	3,0
	100

According to *Klaproth*, b. 1, ſ. 102.

Chemical Characters.

Before the blow pipe it is infuſible without addition, *(Lelievre.)*

Geognostic Situation

Is ſtill unknown. Werner ſuſpects that the grains occur imbedded.

Geographic Situation.

It is found in Brazil, and, according to Count de Bournon, in the ſand of Ceylon, along with rubies, ſapphires, &c.

Uſe.

Uſe.

It is ſometimes cut for ring ſtones, and is uſually ſet with a yellow foil; it is however rare and very ſeldom to be met with in the poſſeſſion of jewellers.

Obſervation.

It is known in commerce by the name of opaleſcent, or oriental chryſolith.

SECOND SPECIES.

Chryfolite.

Krifolith.—*Werner.*

Chryfolithus obfcure virefcens, *Wall.* p. 256.—Kryfolith, *Wid.* 264.—Chryfolité, *Kirw.* vol. 1. p. 262. *Id. Eſtner.* b. 2. f. 122. *Id. Emm.* b. 1. f. 26.—Chryfolito nobile, *Nap.* p. 127. *Peridot. Lam.* t. 2. p. 250.—La Chryfolithe, *Broch.* t. 1. p. 170. *Peridot. Hauy.* t. 3. p. 198.

External Characters.

Its chief colour is piſtachio green, of all degrees of intenfity: fome varieties approach to the olive green, others to grafs green, and even to broccoli brown. Certain rare varieties exhibit fpots of a clove brown colour. In fome fpecimens, befides the green colour, cherry red tints are to be obferved.

It occurs fometimes in original angular pretty ſharp edged pieces, which are frequently notched, and exhibit a peculiar rough fcaly fplintery furface; alfo in rolled pieces, and cryſtallized.

Its cryſtallizations are as follows:

1. A broad rectangular four-fided prifm, having its lateral edges fometimes truncated, fome-

times

times bevilled, and acuminated by fix planes of which two oppofite ones are placed on the fmaller lateral planes, and the other four on the planes formed by the truncation of the lateral edges. The fummit angle formed by the meeting of the four planes is more acute than that formed by the meeting of the two.

2. Differs from the preceding only in having two additional acuminating planes which are fet on the larger lateral planes, between the planes which are fet on the truncating planes.

3. The figures No. 1 and 2 have fometimes their fummits truncated by a cylindrical convex plane, the curvature of which extends between the fmaller planes of the acumination.

4. Some cryftals are fo thin that the fmaller lateral planes almoft entirely difappear, and the larger ones are a little curved, fo that the cryftal has a tabular afpect.

The lateral planes are deeply longitudinally ftreaked. The cryftals are fmall and middle fized.

The external furface of the cryftals is fplendent, internally fplendent and vitreous.

Fracture perfectly conchoidal.

Fragments indeterminately angular fharp edged.

It is perfect and duplicating tranfparent.

Hard in a low degree.

Brittle.

Eaſily frangible.

Not particularly heavy, approaching to heavy.

Specific gravity—3,340, 3,410, *Werner.*—3,428, *Hauy.*

Chemical Characters.

Before the blow pipe it is infuſible without addition; with borax it forms a tranſparent green glaſs. *Vauquelin.*

Conſtituent Parts.

	Cryſtalized.	Cut.	Cryſtalized.
Silica	38,0	39	38
Magneſia	39,5	43,5	50,5
Oxyd of iron,	19,0	19,0	9,5
Loſs	3,5		2,0
	100	101,5	100
	Klaproth.		*Vauquelin.*

Geognostic Situation

Is not well known; Werner ſuſpects that it occurs imbedded.

Geographic

Geographic Situation.

Is found principally in Upper Egypt: it has been alſo found in Bohemia; and, according to Brochant, in the iſle of Bourbon.

Uſe.

It is employed as a precious ſtone in different kind of jewellery, but on account of its inferior hardneſs not very highly valued.

Obſervations.

1. Werner is of opinion that the ſtone deſcribed by the ancients, under the name of yellow chryſolite, is not the true chryſolite, but our Topaz.

2. Romé de Liſle and Born have deſcribed ſpargel ſtone by the name chryſolite; and other writers have confounded it with chryſoberyl and oil green beryl; and ſeveral of the moſt diſtinguiſhed French mineralogiſts ſtill conſider it but as a variety of Olivine.

THIRD SPECIES.

Olivine.

Olivin.—*Werner.*

Chryfolite en grains irreguliers, *De Born.* t. 1. p. 70. —Olivin, *Wid.* f. 261. *Id. Kirw.* vol. 1. p. 263. *Id. Emm.* b. 1, f. 35—Cryfolito commune, *Nap.* p. 131. Olivine, *Lam.* t. 2. p. 278. *Id. Broch.* t. 1. p. 175.—Peridot granuliforme, *Hauy.* t. 3. p. 205.

External Characters.

Its moft frequent colour is afparagus green of different degrees of intenfity; feldom inclining to olive and piftachio green. An intermediate colour between afparagus and olive green may be confidered as its characteriftic colour.

When it is weathered it paffes into a kind of yellowifh brown.

It occurs imbedded, alfo in roundifh pieces, and grains, and, very rarely, cryftallized in rectangular four-fided prifms.

Internally it is fhining, fometimes inclining to gliftening, fometimes to fplendent; and is refinous.

It

It has an imperfectly ſmall conchoidal fracture, which paſſes ſometimes into the ſplintery and uneven. The cryſtalized has ſometimes an imperfectly foliated fracture, with a two-fold cleavage, and ſuch varieties poſſeſs the greateſt tranſparency and luſtre.

Its fragments are indeterminately angular and ſharp edged.

The larger pieces and grains ſhow a tendency to ſmall grained diſtinct concretions.

Semitranſparent, which paſſes into tranſlucent and tranſparent.

Very eaſily frangible.

In a low degree hard.

Not particularly heavy.

Specific gravity—3,225, *Werner*.—3,265, *Klaproth*.

Chemical Characters.

Before the blow pipe it is nearly infuſible without addition; with borax it melts into a dark green bead. It loſes its colour in nitrous acid, the acid diſſolving the iron, which is its colouring ingredient.

Constituent

Constituent Parts.

	Olivine of Unkel.			Olivine of Karlsberg a little decompofed.
Silica	48	to	50	52
Magnefia	37	to	38,50	37,75
Lime	0,25	alfo	0,20	0,12
Oxyd of iron	12,5	alfo	12,0	10,75
Lofs	2,25			
	100,62		100,70	100,62

Klaproth, b. 1. f. 112.

Geognostic Situation.

It occurs imbedded in bafalt, and is generally accompanied with augite. Brochant fuppofes that it is fometimes of a pofterior origin to the rock in which it is found, becaufe it occurs in roundifh pieces that appear to have filled pre-exifting fpaces; he has not, however, adduced any fact to render this opinion probable. Karften mentions that he found boulders of olivine inclofed in the bafalt, behind Landeck in the county of Glatz *. This will not appear improbable, when we recollect that the neweft floetz trap has been often repeated; contemporaneous pieces may, however, have been miftaken for rolled pieces.

* Neue fchriften dar Gefellfch. naturfors. Freunde. Berlin, b. 1. f. 266.

Geographic

Geographic Situation.

It occurs very abundantly in Bohemia; alſo in Hungary, Stiermark, Auſtria, France, England, Ireland, Scotland, Sweden, Iceland, and Norway. Pieces the ſize of a man's head are found in the Habichtwalde and at Lichtenwalde.

Obſervations.

1. Hauy unites this ſpecies with the chryſolite, and names it peridot granuliforme. This arrangement cannot be admitted, becauſe olivine differs from chryſolite or peridot in colour, in form, in frequency of cryſtallization, in having diſtinct concretions, and poſſeſſing greater frangibility.

2. The name olivine is derived from the olive green colour, which is characteriſtic of it.

FOURTH SPECIES.

Augite.

Augit.—*Werner.*

Pyroxene, *Daub.* p. 11.—Augit, *Eſtner*, b. 2. f. 129. *Id. Emm.* b. 3. f. 241.—Volcanite, *Lam.* t. 2. p. 327.—L'Augite, *Broch.* t. 1. p. 179.—Pyroxene, *Hauy.* t. 3. p. 80.

External Characters.

Its chief colour is blackiſh green, which ſometimes paſſes into greeniſh black; it ſeldom paſſes to leek green and ſtill ſeldomer into a kind of liver brown.

It occurs moſtly in indeterminately angular pieces and roundiſh grains, and ſometimes cryſtallized. Its cryſtallization is as follows:

Broad rectangular ſix-ſided priſm, with two broader and four ſmaller lateral planes, bevilled on both extremities, and the bevilling planes ſet obliquely but parallely on thoſe lateral edges, which are formed by the ſmaller lateral planes. When theſe edges are truncated it forms an eight-ſided priſm, where the bevilling

villing planes are ſet on the two ſmaller oppoſite lateral planes *.

The cryſtals are moſtly ſmall, ſeldom middle ſized, and are all around cryſtallized, and imbedded.

Internally its luſtre is ſhining, which approaches ſometimes to gliſtening, ſometimes to ſplendent, and is reſinous.

Its fracture is uneven, paſſing to imperfectly ſmall conchoidal, and approaching ſometimes to perfectly conchoidal. Some varieties, particularly the cryſtallized, preſent an imperfectly foliated fracture, which paſſes into perfectly foliated, with a twofold obliquely interſecting cleavage †.

Fragments indeterminately angular, pretty ſharp edged.

It is only tranſlucent, and faintly tranſparent, on account of the darkneſs of its colours : the ſplendent variety, with conchoidal fracture, poſſeſſes the greateſt degree of tranſparency.

Hard.

Not particularly eaſily frangible.

Not particularly heavy, approaching to heavy.

Specific gravity — 3,471, *Werner*.—3,777, *Reuſs*.—3,2265, *Hauy*.

* It is ſaid to occur alſo in twin cryſtals.

† Dr. Reuſs aſſerts that he obſerved a threefold cleavage, and Brochant ſtates the ſame obſervation. The ſhape of the fragments ſhews this to be a miſtake.

Chemical Characters.

Before the blow pipe, in ſmall pieces, it is with difficulty converted into a black enamel.

Constituent Parts.

Silica	52,00
Lime	13,20
Alumina	3,33
Magneſia	10,00
Oxyd of iron	14,66
—— of manganeſe	2,00
Loſs	4,81
	100,00

Vauquelin. J. d. M. N. 39. p. 175.

Geognostic Situation.

It occurs principally in baſalt, and either alone or accompanied with olivine.

Geographic Situation.

It is found very abundantly in Bohemia, alſo at Landeck in the county of Glatz, in Tranſilvania, in Hungary,

Hungary, in Heſſe, in Saxony near Aunaberg, in Scotland, as at Arthur's Seat near Edinburgh, and remarkably fine in the Iſland of Rume, one of the Hebrides, and equally beautiful at Arendal in Norway.

Obſervations.

1. Augite is diſtinguiſhed from olivine by its darker colours, different cryſtallization, greater hardneſs, and ſpecific gravity. It alſo reſiſts decompoſition much longer than olivine.

2. Olivine, augite, and hornblende, particularly the baſaltic, appear to have much affinity with each other.

3. It uſed formerly to be conſidered as a product of fire; but the circumſtance of its occurring wrapped up, not imbedded in the lava, demonſtrates, as was firſt obſerved by Werner, that it is one of the conſtituent parts of the mother ſtone, which has eſcaped fuſion.

[illegible]

FIFTH SPECIES.

Vefuviane.

Vefuvian.—*Werner*.

Hyacinth du Vefuve, *Rome de L.* t. 2. p. 291.—Vulcanifcher fchorl, *Wid.* f. 290.—Vefuvian, *Eftner.* b. 2. f. 177. *Id. Emm.* b. 1. f. 342.—Hyacinthine, *Lam.* t. 2. p. 323.—La Vefuvienne, *Broch.* t. 1. p. 184.—Idocrafe, *Hauy.* t. 2. p. 574.

External Characters.

Its principal colour is dark olive green, which fometimes paffes into blackifh green, fometimes to liver brown, and borders even on reddifh brown. It occurs alfo of a light olive green, which inclines to oil green.

It occurs maffive, often alfo cryftallized. Its cryftalline figures are as follows:

Rectangular four-fided prifm, pretty deeply truncated on the terminal and lateral edges, and the edges of the truncation flightly truncated.

Sometimes the truncations on the terminal edges are fo large, that they become acuminating ones, and thus the prifm is flatly acuminated by four planes, which

which are ſet on the lateral planes. The ſummit of the acumination is often more or leſs deeply truncated.

The lateral planes are ſlightly longitudinally ſtreaked, but the planes of acumination are ſmooth.

The cryſtals are moſtly ſhort and placed on one another, and form druſes; ſeldom imbedded; are ſmall and middle ſized.

Externally the ſurface of the cryſtals alternates between gliſtening and ſplendent; internally it is gliſtening, and the luſtre intermediate between vitreous and reſinous.

Fracture ſmall grained uneven.

It ſhews a tendency to ſmall grained diſtinct concretions.

Tranſlucent, approaching ſometimes to ſemitranſparent.

Hard, but not in a very high degree.

Not particularly heavy, approaching to heavy.

Specific gravity—3,575, *Werner.*—Of Veſuvius 3,420, of Siberia 3,365 to 3,390, *Klaproth.*—3,407, *Hauy.*

Chemical Characters.

Before the blow pipe it melts, without addition, into a yellowiſh and faintly tranſlucent glaſs.

Constituent

Constituent Parts.

Vesuviane of Vesuvius,		of Siberia.
Silica	35,50	42,0
Lime	33,0	44,0
Alumina	22,25	16,25
Oxyd of iron	7,5	5,50
—— of manganese	0,25	scarcely perceptible.
	98,50	97,75

Klaproth, b. 2. p. 32. & 38.

Geognostic and Geographic Situations.

It is found among the exuviae of Vesuvius, in a rock composed of mica, hornblende, garnet, and calc spar, which is supposed by Werner to constitute part of the primitive mass on which that celebrated volcanic mountain rests. It has been also found in Siberia, in the peninsula of Kamtschatka, at the mouth of the rivulet Achtaragada; but the nature of the rock in which it there occurs remains still undetermined.

Use.

At Naples it is cut into ring stones, and is sold under various names, as chrisolite, hyacinth, &c.

Observation.

Obſervations.

It has been deſcribed under various denominations, as volcanic ſchorl, chryſolite, hyacinth, and topaz: Werner gave it its preſent name and place in the ſyſtem. The finest [illegible] of this mineral [illegible] is in the [illegible] Museum —

SIXTH SPECIES.

Leuzite.

Leuzit.—*Werner*

Grenat d'un blanc criſtallin, et grenat dicolore. *R. d. L.* p. 330.—Grenat d'un blanc mat a 24 facettes. *Born,* t. 1, p. 436. *Leuzit. Wid.* ſ. 292.—Veſuvian or white garnet, *Kir.* vol. 1. p. 285.—Leuzit. *Eſtner.* b. 2. ſ. 188. *Ibid. Emm.* b. 1. ſ. 348. *Ibid. Lam.* t. 2. p. 259. *Id. Broch.* t. 1. 188. *Amphigene Hauy.* t. 2. p. 559.

External Characters.

Its colours are yellowiſh and greyiſh white; theſe, although rarely, paſs into light aſh grey, or yellowiſh grey; and it very ſeldom occurs reddiſh white.

It occurs moſt frequently in original, round, and angular grains; alſo cryſtallized, in acute, double, eight-ſided pyramids, in which the lateral planes of the one are ſet on the lateral planes of the other, and the ſummits are deeply and flatly acuminated by four planes, which are conformably-wiſe ſet on the alternate edges.

The cryſtals often ſhew a tendency to form grains, and conversly the grains to form cryſtals.

The cryſtals are always all around cryſtallized and imbedded; they are commonly ſmall, ſeldom middle ſized.

The ſurface of the grains is rough, and dull, or weakly glimmering; that of the cryſtals is ſmooth, ſeldom ſlightly ſtreaked, and gliſtning. Internally it is ſhining, approaching to gliſtning, and the luſtre is vitreous, which inclines a little to reſinous.

Fracture imperfectly and flat conchoidal, and inclines ſometimes to foliated.

Fragments indeterminately angular, pretty ſharp edged.

It is tranſlucent, ſemitranſparent, and ſome varieties approach to tranſparent.

Hard in a low degree.

Brittle.

Eaſily frangible.

Not particularly heavy, almoſt approaching to light.

Specific gravity.—2,468, *Briſson*.—2,464, *Kirwan*.—2,455 *to* 2,490, *Klaproth*.—2,461, *Karſten*.

Chemical

Chemical Characters.

Before the blowpipe it is infufible without addition: with borax it forms a brownifh-tranfparent glafs. According to Lampadius, when expofed to a ftream of oxygen gas, it melts eafily into a white tranfparent glafs.* Efmark affirms, that before the blow pipe it is fufible without addition† : it is probable, however, that his experiments were made on a variety of cubic zeolite.

Conftituent Parts.

Mean of different analyfis.

Silica	54	56
Alumina	24	20
Potafh	21	20
Lime		2
Lofs	1	2
	100	100
	Klaproth.	*Vauquelin.*

* Lampadius Samml. prakt. chem. Abhandl. b. 2. f. 62.
† Newes bergmänn. journ. 1798. b. 2. f. 21.

Geognostic

Geognoſtic Situation.

It occurs in rocks belonging to the neweſt floetz trap formation, particularly in baſalt; alſo in lava. Von Buch and other mineralogiſts conſider leuzite as of volcanic origin; but Werner is decidedly of opinion that it is part of the mother ſtone unaltered. His proofs will be fully ſtated in the Geognoſie.

Geographic Situation.

It is found near Naples, and in the neighbourhood of Rome.

Obſervations.

1. It was named by Bergman White Garnet. It differs from garnet, however, in colour, hardneſs, and weight: hence Werner conſidered it to be a diſtinct ſpecies, and on account of its natural alliances placed it between veſuvian and melanite, and from its characteriſtic white colour, gave it the name leuzite.

2. It ſometimes weathers to a white earth in the manner of felſpar; this is probably owing to the loſs of a portion of its alkali.

SEVENTH SPECIES.

Melanite.

Melanit.—*Werner.*

Black garnet of mineralogifts.

External Characters.

Its colour is velvet black, which fometimes inclines to greyifh black.

It occurs cryftallized; probably alfo in grains.

Its cryftalline figure is a fix-fided prifm, flatly accuminated by three planes, which are placed on the alternate lateral edges; and the edges are more or lefs truncated.

It is all around cryftallized, and confequently has been formed imbedded.

Its cryftals are middle fized and fmall.

Externally it is always fmooth, and fhining, which fometimes approaches to fplendent. Internally it is fhining, inclining to gliftning.

Fracture imperfectly flat conchoidal: ſometimes with a tendency to foliated, which ſhews a double obliquely interſecting cleavage.

Fragments indeterminately angular and ſharp edged.

Opaque.

Hard.

Pretty eaſily frangible.

Not particularly heavy,

Specific gravity—3,800, *Werner*—3,691, *Karſten.*

Constituent parts.

Silica	35
Alumina	6
Lime	32
Oxyd of Iron and Marganeſe	25
	98

Vauquelin.

Geognostic Situation.

It occurs imbedded in rocks belonging to the neweſt floetz trap formation.

Geographic

Geographic Situation.

It has been hitherto found only in Italy, at Frescati and St Albano near Rome.

Obſervations.

1. It was formerly confounded by mineralogiſts with garnet and ſhorl. To Werner we are indebted for the firſt accurate and ſatisfactory account of its external characters.

EIGHTH SPECIES.

Garnet.

Werner divides this ſpecies into two ſubſpecies, the precious garnet, and common garnet.

FIRST SUBSPECIES.

Precious Garnet.

Edler Granat.—*Werner.*

Oriental garnet, *Kirw.* vol. 1. p. 258.—Edler granat, *Emm.* b. 1. ſ. 358. *Almandine Karſt. Tab.*—Le grenat noble *Broch,* t. 1. p. 193.

External Characters.

All its colours are red, and it paſſes from columbine red into cherry red, and from this into a colour intermediate between cherry and blood red, and it appears even to run into browniſh red. All theſe colours contain an intermixture of blue, but very ſeldom black.

It

It occurs very feldom maffive, more often diffeminated, and in original roundifh grains and fmall pieces. It occurs moft commonly cryftallized, and has two principal cryftallizations, viz.

1. The garnet dodecaedron.
2. The double eight-fided pyramid.

a. Garnet dodecaedron. This figure is either perfect, or more or lefs truncated on all its edges. When thefe truncations increafe, and caufe the original faces of the dodecaedron to difappear, an

b. Acute double eight-fided pyramid is formed, in which the lateral planes of the one are fet on the lateral planes of the other, and the fummits are deeply and flatly acuminated by four planes, which are conormably-wife fet on the alternate lateral edges.

c. The fame figure as the preceding, in which the eight acute angles, formed by the meeting of the acuminating and lateral planes, and the alternate angles on the common bafis, are truncated.

d. Rectangular four-fided prifm, acuminated on both extremities by four planes, which are fet on the lateral edges.

The cryftals are moftly fmall, alfo middle fized, feldom large, and always all around cryftallized. Surface of the cryftals is fometimes fmooth, particularly the planes of truncation: the planes of acumination are fometimes diagonally ftreaked. Surface of thegrains is rough or granulated.

Externally the cryſtals and grains are gliſtening, internally the luſtre alternates from ſhining to gliſtning, bordering on ſplendent, and is vitreous, inclining a very little to reſinous.

Its fracture is perfectly conchoidal, which often paſſes into imperfectly conchoidal, which again, although very rarely, verges on coarſe grained uneven, and ſplintery: Sometimes a concealed foliated fracture, is to be obſerved*.

Its fragments are indeterminately angular, more or leſs ſharp edged.

It ſometimes occurs in lamellar diſtinct concretions.†

It alternates from completely tranſparent to tranſucent acccording to the kind of fracture‡.

Pretty hard.||

Brittle.

Not particularly difficultly frangible.

Not particularly heavy, paſſing into heavy§.

Specific gravity.—4,230. *Werner.*—4,085, *Klaproth.*——4,352, *Karſten.*—4,188.—*Briſſon.*

* Conchoidal variety has greateſt, and coarſe grained uneven the leaſt luſtre.

† The diſtinct concretions occur moſt frequently in that from Greenland.

‡ The tranſparent varieties are often impure in the middle.

|| Scratches quartz.—*Hauy.*

§ After Zircon it is the heavieſt of the precious ſtones.

Constituent parts.

Silica	35,75
Alumina	27,25
Oxyd of Iron	36, 0
Manganese	0 ,25
Loss	0 ,75
	100

Klaproth, s. 2. p. 21. to 26.

Chemical Characters.

Before the blow pipe it melts pretty easily into a black enamel.

Geognostic Situation.

It occurs almost always in primitive rocks, particularly in mica slate, serpentine, chlorite slate, also in primitive mineral beds.

Geographic Situation.

It is found in Europe; in Greenland, Norway, Sweden, Scotland (in Aberdeenshire, Rossshire, and the Long Island), Saxony, Bohemia, Silesia, Switzerland,

Switzerland, Stiermark, Tirol, Hungary, Salzburg, and France. In Afia, in Armenia, Pegu, Ceylon, Siberia. In Africa, Æthiopia and Madagafcar. In America, Brazils.

Ufe.

It is cut as a precious ftone, and used for necklaces, bracelets, and rings.

Obfervations.

1. The oriental or precious garnet appears, from the defcription of Pliny, to be the carbuncle of the ancients.—*Werner.*

2. Its name is derived from its red colour, which approaches much to that of the fruit and flower of the pomegranate.

SECOND SUBSPECIES.

Common Garnet.

Gemeiner Granat.

Brown and green are its moſt common colours. Of brown it occurs liver brown, yellowiſh brown, and reddiſh brown; and of green, blackiſh green. From liver brown it paſſes into olive, piſtacio, blackiſh and leek green, and from this even into mountain green: from yellowiſh brown it paſſes into iſabella yellow: from reddiſh brown into a middle colour between hyacinth and blood red: from blackiſh green into greeniſh black.

In many ſpecimens different colours occur together. It occurs moſt commonly maſſive, but never in grains or angular pieces. This is characteriſtic of it.

Sometimes cryſtallized, and poſſeſſes all the figures of the precious garnet, with the exception of the cryſtal, No. 4. They are always ſimply aggregated, and form druſes. Seldom middle ſized, commonly ſmall, and very ſmall.

Surface of the cryſtals, and particularly the dodecaedron, diagonally ſtreaked, ſhining, and gliſtening.

Internally it is almoſt always gliſtening, ſeldom ſhining.

Luſtre intermediate between reſinous and vitreous.

Fracture fine grained uneven, ſometimes inclining a litttle to the imperfectly conchoidal.

Fragments indeterminately angular, not particularly ſharp edged.

It occurs in ſmall, and fine angularly grained, diſtinct concretions, which ſometimes paſs into coarſe grained.

More or leſs tranſlucent, the black nearly opaque.

Not particularly hard.

Eaſily frangible.

Heavy in a middling degree.

Specific gravity.—3,757, 3,754, *Werner.*—3,668, *Karſten.*

Chemical Characters.

It is more eaſily melted than the precious garnet.

Constituent Parts.

	Wiegleb.	Merz.
Silicia	26,46	40
Alumina	22,70	20
Lime	17,91	8
Iron	16,25	20
Lofs	16,68	12
	100	100

Voight's Mineralog. und bergmann. Abhandlungen. Th. 1, f. 15 and 22.

Geognostic Situation.

It occurs in beds in the older primitive rocks, particularly in mica flate and clay flate. It is often accompanied with different kinds of ore, as copper pyrites, iron pyrites, magnetic iron ftone, lead glance, and brown blende.

Geographic Situation.

It is found in Hungary at Dognatzka, Orbitz, and Wadarna; in Bohemia, in the Bunzlauwer circle; in Saxony, at the devil's ftone, near Schwartzenberg; the Krebfberg, near Ehrenfriedendorf; Schneeberg, Berggiefshübel, Breitenbrun and Geier. Arendal, in Norway;

Norway; at Garpenberg, Fahlun, and Dannemora, in Sweden; in Siberia, and many other places on the continent of Europe; it is alſo found in Ireland.

Uſe.

On account of its eaſy fuſibility and richneſs in iron, it is frequently employed as a flux in ſmelting rich iron ores, and as an addition to poor ores. In ſome countries it is named green iron ore. It is ſeldom cut or poliſhed for ornamental purpoſes.

Obſervations.

1. It is diſtinguiſhed from the precious garnet by colour, degree of tranſparency, luſtre, kind of fracture, diſtinct concretions, druſes, aggregation of cryſtals, ſpecific gravity, occurring in beds, and not being imbedded.

2. Karſten conſiders the precious garnet as a diſtinct ſpecies, and names it almadine, but places the common garnet and pyrope together.

NINTH SPECIES.

Pyrope.

Pyrop.—*Werner*.

Bohemian Garnet of many mineralogifts.—Precious Garnet of Karften.

External Characters.

Its colour is dark blood red, which, when held between the eye and the light falls ftrongly into yellow *.

It occurs in fmall and middle fized roundifh and angular grains, which are imbedded, but never cryftallized.

Luftre fplendent and vitreous.

Fracture perfectly conchoidal.

Fragments indeterminately angular and fharp edged.

Completely tranfparent.

Hard †.

* Pyrope and garnet, when cut and polifhed, are eafily diftinguifhed from fpinelle and fapphire, by the dark tinge which their colours poffefs, *Hauy*, t. 2. p. 544.

† Scratches quartz. *Hauy*.

Not particularly heavy, approaching the heavy. Specific gravity—3,941, *Werner.*—3,718, *Klaproth.*

Constituent Parts.

Silica	40,0
Alumina	28,50
Magnefia	10,00
Lime	3,50
Oxyd of iron	16,50
—— of manganefe	0,25
Lofs	1,25
	100

Klaproth, t. 2. p 21.

Geognoftic and Geographic Situation.

Occurs imbedded in ferpentine at Zœblitz in Saxony, and in Wacce in the Bohemian Mittelgebirge.

In Bohemia it is moft commonly found in alluvial land, which has been formed by the decompofition of the neighbouring floetz trap rocks, accompanied with cryftals of fapphire and hyacinth. At the Ely in Fifefhire in Scotland, it is found in the fand on the fea fhore, and is probably derived from the neighbouring floetz trap rocks.

Ufe.

Ufe.

It is employed in almoft every kind of jewellery, and is generally fet in a gold foil. The fmall and very fmall grains are powdered, and ufed in place of emery in cutting fofter ftones.

Obfervations.

This foffil ufed to be confidered as a variety of the precious garnet, and was generally known by the name of Bohemian garnet, from its occurring in that country in great beauty and perfection. Lately, however, Werner has introduced it into the fyftem as a diftinct fpecies, on account of its colour, tranfparency, and want of cryftallization. The name pyrope is borrowed from Pliny and Ovid, who mention a foffil which is confidered by Werner as nearly allied to the ftone now known by that name.

TENTH SPECIES.

Grenatite.

Granatit.—*Werner*.

Grenatite, *Sauſſure*, ſ. 1900. *Id. Lam.* t. 2. p. 290. *Id. Brochant*, t. 2. p. 406.—Staurotide, *Hauy*, t. 3. p. 93.

External Characters.

Its colour is dark reddiſh brown.

It is always cryſtalized; its figure is a broad ſix-ſided priſm, in which the four broadeſt planes meet two and two under obtuſe angles. It is ſometimes bevilled, and the bevilling planes are ſet on the obtuſer edges, which are formed by the meeting of the broader lateral planes.

Surface ſometimes ſmooth and gliſtening, ſometimes uneven.

The cryſtals are ſmall and middle ſized: are imbedded and interſect each other, either at right angles, or more or leſs obliquely.

Internally it is gliſtening, and its luſtre is between vitreous and reſinous.

Fracture

Fracture intermediate between ſmall grained uneven, and imperfectly conchoidal *.

Fragments indeterminately angular.

Very often opaque, ſometimes tranſlucent, and very rarely ſemitranſparent.

Hard †.

Brittle.

Eaſily frangible.

Not particularly heavy.

Specific gravity—3,286. *Hauy.*

Chemical Characters.

Infuſible before the blow pipe.

Constituent Parts.

Silica	0,33
Alumina	0,44
Lime	0,0384
Oxyd of iron,	0,13
—— of manganeſe	0,01

Vauquelin, J. d. M. N. 53. p. 453.

* Brochant remarks that it is imperfectly foliated, and that the folia are parallel with the axis; but in other directions fine grained, uneven, and ſometimes conchoidal. *Broch.* t. 2. p. 497.

† Scratches quartz feebly. *Hauy.*

Geognostic

Geognostic and Geographic Situation.

It is found in St Gothard in Switzerland, imbedded in mica ſlate, and ſometimes accompanied with Kyanite. It is alſo met with in Brittany in France, and in Spain near St Jacques de Compoſtelle.

ELEVENTH SPECIES.

Spinelle.

Spinell.—*Werner.*

Rubinus balaſſus, Rubinus ſpinellus, *Wall.* t. 1. p. 247.—Rubis ſpinelle octaedre, *Rome d. L.* t. 2. p. 224.—Spinel, and balaſs rubies, *Kirw.* vol. 1. p. 253.—Spinell, *Eſtner*, b. 2. ſ. 73. *Id. Emm.* b. 1. ſ. 56. & b. 3. ſ. 252. Rubino ſpinello, *Nap.* p. 118.—Rubis, *Lam.* t. 2. p. 224. Spinell, *Hauy* and *Brochant*, *Ib. Bournon, Philoſ. Tranſ.* 1792, part 2. p. 305.

External Characters.

Its principal colour is red, from which it paſſes on the one ſide into blue, and even into green, on the other into yellow and brown. From carmine red it paſſes

paſſes on the one ſide into crimſon, cochineal, and cherry-red, and from this into plumb, violet, and indigo blue, and into a variety of green, which is very rare *; on the other ſide it paſſes from carmine-red through blood-red into orange yellow, and from this into a middle colour between clove brown and reddiſh brown. It occurs alſo reddiſh white.

Its colours are moſtly deep (the reddiſh white is the only pale colour), and they have always a ſhade of black. Sometimes it is enveloped in an opaline cruſt, ſometimes it exhibits an opaleſcent irideſcence, and others when cut exhibit ſtars of three and ſix rays †.

It occurs in grains which, from their aſpect, ſhew that they have been rolled, alſo cryſtallized.

1. Perfect octaedron.
2. Lengthened or cuneiform octaedron.
3. When ſix faces of the perfect octaedron are enlarged at the expence of the other two, one in each pyramid, which at length entirely diſappear, a very acute rhomboid is formed.
4. When four alternate planes of the octaedron grow large at the expence of the others, which at length diſappear, a tetraedron is formed: the tetraedron is ſometimes truncated on the angles, and often ſo deeply that only thin ſegments remain.

* The ceylanite of La Metherie, or pleonaſt of Hauy, which is here mentioned as a green coloured variety of ſpinelle, may poſſibly be found to be a ſubſpecies of ſpinelle; but we have no reaſon for believing it to be a diſtinct ſpecies.

† Theſe rayed varieties are, by Count de Bournon, referred to the oriental ruby.

5. Sometimes

5. Sometimes the edges of the common bafis of the octaedron are truncated, and, in fome varieties, fo deeply, that a rectangular four-fided prifm, acuminated by four planes, is formed *.

6. Sometimes all the edges of the octaedron are truncated. When thefe truncations become fo large as to caufe the original faces to difappear, the garnet dodecaedron is formed.

7. Sometimes each of the angles of the octaedron are acuminated by four planes, which are placed on the lateral planes †.

8. Six-fided table, in which the terminal planes are fet alternately ftraight and oblique on the lateral planes. It may alfo be viewed as an octaedron, in which two diagonally oppofite planes have increafed very much in proportion to the others.

9. When two fegments of the tetraedron are joined by their bafis, a twin cryftal, having three re-entring angles, is formed.

10. When three fegments are joined, a triple cryftal is formed ‡.

* This variety was firft defcribed by Count de Bournon, and, as far as I recollect, does not exift in the cabinet of Werner.

† This is defcribed by Bournon as a variety of ceylanite.

‡ Befides the cryftals above enumerated, Werner mentions the following as belonging to this fpecies: 1. Six-fided prifm, having its alternate and alternating angles truncated. 2. Cube truncated on the two diagonally oppofite angles. It would appear, however, from the obfervations of Bournon, that thefe varieties rather belong to the oriental ruby.

The

The cryſtals are ſmall and very ſmall, very rarely middle ſized, and probably all around cryſtallized.

Planes generally ſmooth.

Externally and internally its luſtre is ſplendent and vitreous.

Fracture nearly perfectly flat conchoidal, and ſometimes imperfectly foliated.

Fragments indeterminately angular, ſharp edged.

It alternates from tranſlucent to tranſparent.

Hard in a high degree, but can be ſcratched by ſapphire.

Not particularly heavy, approaching to heavy.

Specific gravity—3,700, *Werner*.—3,645, *Hauy*.—3,570, *Klaproth*.

Chemical Characters.

Before the blow pipe it is unalterable without addition, but is fuſible with borax.

Conſtituent Parts.

Alumina	74,50	82,47
Silica	15,50	
Magneſia	8,25	8,78
Oxyd of iron	1,50	
Chromic acid		6,18
Lime	0,75	
Loſs		2,57
	100,50	100
	Klaproth, t. 2. p. 10.	*Vauquelin*, *J. d*, *M.* N. 38. p. 89.

Geognostic Situation.

Werner is of opinion that it occurs in rocks belonging to the neweſt floetz trap formation. In the magnificent collection belonging to the Honourable Mr Greville are two intereſting ſpecimens which, although they do not enable us to aſcertain the repoſitory of the ſpinelle, make us acquainted with ſome of its accompanying foſſils. In one of the ſpecimens cryſtals of ſpinelle are imbedded in calcareous ſpar, and accompanied with cryſtals of mica, magnetic pyrites, and a ſubſtance which Count de Bournon believes to be aſparagus ſtone: in the other the ſpinelle is

is imbedded in adularia, and is accompanied with magnetic pyrites *.

Geographic Situation.

It is found in the kingdom of Pegu, and in the iſland of Ceylon, accompanied with zircon, hyacinth, tourmaline, and ceylanite. *Bournon.*

Uſe.

It is employed as a precious ſtone, and is of conſiderable value, but it has neither the hardneſs nor the fire of the oriental ruby. Some varieties are valued with the ruby. It is improved by heating in the fire.

Obſervation.

When ſpinelle and oriental ruby of the ſame colour are cut, we can diſtinguiſh them from each other by the ſuperior hardneſs, and greater ſpecific gravity of the latter.

* The reader is referred to Count de Bournon's very excellent Memoir on Corundum for a more particular account of theſe ſpecimens.

[illegible] the Spinelle

TWELFTH SPECIES.

Sapphire.

Saphir.—*Werner.*

Saphirus, *Wall,* t. 1. p. 248.—Rubinus orientalis, *Ibid.* p. 247.—Topazius orientalis, *Ibid* p. 251.—Rubis d'orient, *R. de L.* t. 2. p. 212.—Oriental ruby, ſapphire, and topaz, *Kirw.* t. 1. p. 250—Sapphir, *Eſtner*, b. 2. ſ. 86. *Id. Emm.* b. 1. ſ. 67. & b. 1. ſ. 251.—Zaffiro et rubin-zaffiro, *Nap.* p. 113. & 121.—Saphir, *Broch.* t. 1. p. 207.—Telesie, *Hauy.* t. 2. p. 480—Perfect corundum, *Greville* and *Bournon. London Philoſ. Tranſ.* 1798 & 1802.

External Characters.

Its principal colour is Berlin blue; but it occurs alſo red, and of all the intermediate varieties that exiſt between theſe two principal colours. It paſſes on the one ſide into indigo blue, on the other into azure, violet, lavender, lilac, and ſky blue, and further into deep green; from the lilac blue it paſſes into peach-bloſſom red, crimſon red, cochineal red, and very rarely into carmine red; from the peach-bloſſom red it paſſes into roſe red and reddiſh white; it has been alſo

alſo obſerved yellowiſh white, and laſtly it paſſes from lavender blue into pearl grey, blueiſh grey, and blueiſh white.

Werner ſuppoſes that the yellowiſh white may paſs into yellow.

It is ſometimes found with two colours at once, as white and blue and blue and red. Werner has in his poſſeſſion a ſapphire which is white in the middle, and at the one end blue and at the other red.

It occurs in ſmall rolled pieces, and cryſtallized. Its cryſtallizations are as follows:

1. Double three-ſided pyramid, in which the lateral planes of the one are ſet on the lateral edges of the other; or it may be conſidered as a ſlightly acute rhomboid.
2. The extremities of the pyramids (or the two diagonally oppoſite angles of the rhomboid) more or leſs deeply truncated, and ſometimes ſo deeply that there is formed a ſix-ſided table, in which the terminal planes are ſet alternately oblique and ſtraight on the lateral planes.
3. Sometimes the common baſis of the pyramids is truncated, and in ſome varieties ſo deeply, that there is formed a rhomboidal ſix-ſided priſm acuminated by three planes, which are ſet on the alternate lateral edges. The extremities of the acuminations are often truncated.
4. Perfect ſix-ſided priſm, which is ſometimes ſo ſhort that it forms a ſix-ſided table.

5. Six-

5. Six-fided prifm truncated on the lateral and terminal edges, and on the alternate angles.
6. When the truncations on the terminal edges increafe there is formed a fix-planed acumination.
7. When the prifm of the preceding figure difappears, a more or lefs acute double fixfided pyramid is formed. The extremities of the pyramid are ufually more or lefs deeply truncated; fometimes truncated on the alternate angles which are formed by the meeting of the truncating plane and the acuminating planes, and very rarely with unaltered extremities.
8. More or lefs acute fingle fix-fided pyramid, in which the extremity is ufually truncated, and fometimes even the edges. In fome rare varieties the alternate angles, formed by the meeting of the truncating plane and the acuminating planes, and alfo the alternate angles of the bafis are truncated.
9. Single fix-fided pyramid flatly acuminated by three planes, which are fet on the alternate lateral edges.

Cryftals fmall and middle fized, and all round cryftallized. The planes of the cryftals are often tranfverfly ftreaked, and, when frefh, are generally fplendent.

Internally its luftre is fplendent and vitreous.

Fracture

Fracture conchoidal in true sapphire *; in those varieties which are denominated oriental ruby it presents a three-fold oblique angular cleavage, which is parallel with the sides of the rhomboid.

Fragments indeterminately angular.

It is more or less transparent, even sometimes passing to translucent, and there are varieties that, when cut, and exposed to the rays of the sun, exhibit a star of six rays.

Hard in the highest degree, resisting the file, but yielding to the diamond.

Easily frangible.

It is heavy.

Specific gravity—From 3,980 to 4,180, *Werner*.—3,994 to 4,283, *Hauy*.—4,000, *Kirwan*.—From 4,000 to 4,083, *Hatchett & Greville*.—3,907 to 4,161, *Bournon*.

Constituent Parts.

Silica	0	35,0
Alumina	98,5	58,0
Lime	0,5	5,0
Oxyd of iron	1,0	2,0
	100	100
	Klaproth, t. 1. p. 88.	*Bergman*.

* Count de Bournon is of opinion that a three-fold cleavage is to be observed in sapphire.

	Sapphire.	Oriental ruby.
Silica	5,25	7,0
Alumina	92,0	90,0
Iron	1,0	1,2
Lofs	1,75	1,8
	100,00	100,00
	Chenevix.	*Id.*

Chemical Characters.

It is infufible without addition before the blow pipe; but with borax it melts without effervefcence.

Geognostic Situation.

Werner fufpects that it occurs in rocks belonging to the neweft floetz trap formation: and it would appear, from the obfervations of the Hon. Mr Greville and Count de Bournon, that it is alfo an inmate of granite, fyenite, and other primitive rocks.

Geographic Situation.

It is found particularly beautiful in the kingdom of Pegu and ifland of Ceylon in the Eaft Indies. It has been alfo difcovered in Portugal; France, in the ftream Expailly; alfo in Bohemia near Meronith and Bilin, at

at the foot of trap rocks, and accompanied by hyacinth, pyrope, and iron ſand.

Uſe.

Sapphire and oriental ruby are, next to the diamond, the moſt valuable of precious ſtones, and are uſed in the fineſt kind of jewellery.

Obſervations.

1. Werner is of opinion that ſapphire and ſpinelle are very nearly allied, and that in ſome inſtances ſpinelle paſſes into ſapphire.

2. The oriental ruby, which is here arranged, in conformity to the method of Werner, along with the ſapphire, appears, from the obſervations of Count de Bournon, to be a diſtinct ſpecies.

It differs from ſapphire in its colour ſuite, in having a diſtinct foliated fracture, in being ſofter and poſſeſſing leſs ſpecific gravity ; and in its geognoſtic character, as it occurs ſometimes imbedded in corundum, which is an inmate of primitive mountains, while ſapphire appears to be more a production of a later period.

3. The violet coloured ſapphire is the oriental amethyſt ; the yellow, the oriental chryſolite and topaz ; and the green, the oriental emerald.

N THIRTEENTH

THIRTEENTH SPECIES.

Corundum.

Korund.—*Werner*.

Ib. Wid. ſ. 237.—Adamantine ſpar, *Kirw.* vol. 1. p. 335. —Demant ſpath, *Emm.* b. 1. ſ. 9. & b. 3. ſ. 229.—Spato adamantino, *Nap.* p. 223.—Corindon, *Lam.* t. 2. p. 356.—Le ſpath adamantine, *Broch*, t. 1. p. 356.—Corindon, *Hauy*. t. 3. p. 1.—Imperfect corundum, *Greville* and *Bournon*. *Philoſ. Tranſ.* 1798 & 1802.

External Characters.

Its colour is greeniſh white of various degrees of intenſity, which paſſes into light greeniſh grey, and even into mountain and aſparagus green; it is ſometimes alſo pearl grey, which paſſes into fleſh red, and in ſome varieties it is reddiſh externally, but greeniſh internally.

It occurs maſſive, diſſeminated, in rolled pieces, and cryſtallized. Its cryſtallizations are ſimilar to thoſe of ſapphire.

The cryſtals are middle ſized and imbedded.

Externally they are dull and rough.

The

The luſtre of the principal and croſs fracture is ſhining and gliſtening, and is intermediate between vitreous and reſinous.

The fracture is foliated, with a three-fold obliquely interſecting cleavage, and the cleavages are parallel with the planes of the rhomboid, or of the alternate angles of the ſix-ſided priſm: croſs fracture is ſmall and imperfectly conchoidal.

Fragments rhomboidal.

It ſhews a tendency to ſtraight lamellar diſtinct concretions.

It is duplicating tranſlucent.

Hard in a high degree, yielding a little to the file*.

Pretty eaſily frangible.

Not particularly heavy, approaching to heavy.

Specific gravity—3,710, *Klaproth.*—3,873, *Hauy.*—3,875, *Bournon.*

Constituent Parts.

	Corundum of the Carnatic.	Of Malabar.
Silica	5,0	7,0
Alumina	91,0	86,5
Iron	1,5	4,0
Loſs	2,5	2,5
	100	100

According to *Chenevix.*

* Scratches quartz. *Hauy.*

Corundum of Bengal.

Alumina	89,50
Silica	5,50
Oxyd of iron,	1,25
Lofs	3,75

According to *Klaproth*.

Geognostic Situation.

It probably occurs imbedded in granite, fienite, or greenftone, as the cryftals of it are often found in a rock compofed of felfpar, quartz, hornblende, and mica.

Geographic Situation.

It is found in the Carnatic and on the coaft of Malabar.

FOURTEENTH SPECIES.

Diamond ſpar.

Demant ſpath.—*Werner.*

External Characters.

Its colour is dark hair brown.

It occurs maſſive, diſſeminated, in rolled pieces, and cryſtallized in

1. Six-ſided priſms, and in
2. Simple very acute ſix-ſided pyramids, having their extremities truncated.

Internally its luſtre is ſplendent, and generally pearly, approaching in a ſlight degree to adamantine. When cut into a ſemicircular ſhape, and in ſuch a manner that the point of interſection of the three-fold cleavage occupies the middle of the ſurface, it preſents an opaleſcent ſtar of ſix rays, and a peculiar pearly light, which is of a copper red colour.

Fracture preſents a perfect obliquely interſecting three-fold cleavage.

Fragments rhomboidal, but not ſo perfect as in corundum.

It is tranſlucent on the edges.

Hard

Hard in a high degree, yielding a little to the file.
Eaſily frangible.
It is not particularly heavy, approaching to heavy.
Specific gravity—3,981.

Constituent Parts.

Diamond ſpar of China.

Alumina	84,00
Silica	6,50
Oxyd of iron	7,50
Loſs	2,0
	100,0

According to *Klaproth.*

Geognostic Situation.

Probably occurs in granite.

Geographic Situation.

Has been hitherto found only in China.

Uſe.

Use.

Both diamond ſpar and corundum are employed in cutting and poliſhing hard minerals.

Obſervations.

1. The great hardneſs of corundum and diamond ſpar, independent of their ſtrong affinity to ſapphire, may be conſidered as juſtifying their removal to the flint genus.

2. The compact corundum of Bournon is probably only a variety of the following ſpecies.

3. It is probable that diamond ſpar is only a variety or ſubſpecies of corundum.

FIFTEENTH SPECIES.

Emery.

Schmiergel.—*Werner.*

External Characters.

Its colour is intermediate between greyiſh black and blueiſh grey.

It occurs maſſive and diſſeminated ; and the maſſive is ſometimes intermixed with other minerals.

Its luſtre is gliſtening, paſſing into glimmering, and is adamantine.

Fracture fine and ſmall grained uneven ; ſometimes even ſplintery.

Fragments indeterminately angular, rather blunt edged.

It ſometimes ſhews fine grained diſtinct concretions.

Is ſlightly tranſlucent on the edges:

Hard in a high degree, ſcarcely yielding to the file.

Not very eaſily frangible.

Heavy.

Constituent Parts.

Alumina	86,0
Silica	3,0
Iron	4,0
Loſs	7,0
	100

According to *Tennant*, *Philoſ. Tranſ.* for 1802.

Specific Gravity is about 4'00 —

Geognostic Situation.

It occurs in beds of talc and ſteatite, and is frequently accompanied with calcſpar and blende.

Geographic Situation.

It is found at Ochsenkopf near Schwartzenberg in Saxony; alſo in great quantity in the iſlands of the Helleſpontic Archipelago, particularly in the iſland of Naxos. It is ſaid alſo to occur in the iſles of Guernſey and Jerſey, on the coaſts of Normandy, and in Spain.

Uſe.

It is uſed for cutting and poliſhing hard bodies; it is even employed for cutting ſapphire and oriental ruby.

Obſervations.

1. Its high degree of hardneſs, and affinity to corundum, have induced me to give it its preſent place in the ſyſtem.

2. May not this, and the four preceding ſpecies, be arranged in the following order?

Ruby Family.

Spinelle.

Sapphire.

a. Sapphire.

b. Oriental ruby.

Corundum.

a. Common corundum.

b. Diamond ſpar.

c. Emery, or compact corundum.

3. Magnetic iron ſtone, and iron glance, from their being employed in place of emery in poliſhing hard bodies, have been confounded with it.

SIXTEENTH SPECIES.

Topaz.

Topaz.*—*Werner.*

Topazius octaedricus prifmaticus, *Wall.* t. 1, p. 251.—Topaze du Brezil, *R. d. L.* t. 2. p. 230.—Topaze de Saxe, *Ibid* p. 260.—Topaz. *Wern. Cronft.* p. 97.—*Ibid. Wid.* p. 267.—Occidental Topaz. *Kirw.* vol. 1. p. 254.—Topaz. *Eftner*, b. 2. f. 98. *Id. Emm.* b. 1. f. 374.—Topazio, *Nap.* p. 136.—Topaze du Brezil, de Saxe et de Siberie, *Lam.* t. 2. p. 254.—*Ibid. Broch.* t. 1, p. 212. *Ib. Hauy*, t. 2. p. 504.

External Characters.

Its principal colour is wine yellow, of all degrees of intenfity. It paffes from the pale wine yellow into yellowifh white, and yellowifh grey, and from this into greenifh white and mountain green, and into a middle colour between mountain green and feladon green, and even into fky blue. From the deep wine yellow it paffes into flefh red, and from this into crimfon red, which borders on lavender and lilac blue. This latter variety is very rare.

* The name Topaz is derived from Topazos, a fmall island in the Red Sea, where it is faid the Romans ufed to collect this ftone.

It occurs maſſive, diſſeminated, ſometimes in rolled pieces, but moſt commonly cryſtallized.

Its cryſtallizations are as follows.

1. Oblique eight-ſided priſm, having four larger and four ſmaller lateral planes, of which always two and two meet under very obtuſe angles; or it may be viewed as an oblique four-ſided priſm, with the two obtuſe edges, more or leſs deeply and obtuſely bevilled.

2. Oblique, four-ſided priſm, which preſents the following varieties.

a. Acuminated by four planes which are ſet on on the lateral planes.

b. The angles which the accuminating planes make with the lateral planes on the acute lateral edges, more or leſs deeply truncated.

c. The four planed acumination again acuminated.

d. The double acumination again acuminated; this forms a triple acumintaion.

e. When the truncation of the angles, which the acuminating planes make with the lateral planes on the acute lateral edges increaſe, a ſix-planed acumination is formed.

f. Sometimes the angles of the obtuſe lateral edges are truncated.

g. Sometimes the angles on the acute lateral edges (*b*) are a ſecond time truncated,

h. Frequently the ſummit of the ſix-planed acumination is more or leſs deeply truncated

and

and this gives us the cryſtalline figure of the Saxon topaz, which may be deſcribed as an obliqne, four-ſided priſm, having its terminal and obtuſe lateral edges bevilled, and the acute angles truncated, and the three angles which lay around the truncating planes, alſo truncated.

When the truncations of the acute angles increaſe, a bevillment is formed, and then little remains of the other bevilling planes: often alſo the obtuſe lateral edges are more or leſs deeply bevilled, and thus is formed an eight-ſided priſm.

The Braſilian topaz generally occurs with acuminations, but without truncations; the Siberian on the contrary is uſually bevilled.

The lateral planes are deeply longitudinally ſtreaked, but the other planes are ſmooth.

The Brazilian and Siberian topaz is more deeply ſtreaked than the Saxon.

The cryſtals are ſmall and middle ſized, very ſeldom large, commonly implanted (aufgewachſen) and in druſes.

Externally it is ſplendent, internally ſplendent and ſhining; luſtre vitreous.

Croſs fracture perfectly ſtraight foliated; the longitudinal ſmall and imperfectly conchoidal.

Fragments indeterminately angular and ſharp edged, ſometimes tabular and ſplintery.

Alternates from tranſlucent to tranſparent, and is duplicating tranſparent.

Hard

The maſſive occurs in coarſe and fine grained diſtinct concretions.

Hard in a high degree yielding a little to the file.*

Eaſily frangible.

Intermediate between not particularly heavy, and heavy.

Specific gravity — 3,464 to 3,556 *Werner.* — 3,556 to 3,564, *Hauy.*—3,540 to 3,576, *Karſten.*

Chemical Characters.

Saxon topaz in a gentle heat turns white,† but a ſtrong heat deprives it of luſtre and tranſparency: the Brazilian, on the contrary, by expoſure to a high temperature burns roſe red,‡ and in a ſtill higher, violet blue. Before the blow pipe it is ſcarcely fuſible, but expoſed to a ſteam of oxygen gas it ſoon melts into a porcellanous bead. It is fuſible with borax, but alkali has little effect on it.

Phyſical Characters.

The topaz of Brazil, Siberia, and Mucla in Aſia Minor, when heated exhibit at one extremity poſitive, and the other negative electricity. The Saxon, by friction, gives ſigns of electricity.

* It cuts quartz, but is cut by ruby.—*Hauy.*

† When thus altered the Saxon topaz is ſometimes ſold for diamond.

‡ Topaz thus altered is cut and ſold by jewellers under the name of Brazilian ruby and pale ſpinelle.

Constituent

Constituent Parts.

Silica	31	39
Alumina	68	46
Lofs	1	
Lime		8
Iron		6
	100	99
	Vauquelin, J. d. M. No. 24, p. 4. It is Saxon topaz.	Bergmann Opufc. vol. 2. p. 96.

Geognostic Situation.

It is found in veins, that traverfe primitive rocks, accomompanied by fluor fpar, tin ore, and arfenical pyrites; but its moft peculiar repofitory is in that kind of rock, denominated by Werner topaz rock, which is an aggregate of topaz, quartz, and fchorl, having in the fmall a flaty, but in the great a granular texture. The Siberian is found accompanied with beryl, in that variety of granite which has received the fanciful name of Pierre Graphic.

Geographic Situation.

It is found in Brazil, in Siberia among the Uralian mountains, particularly at Adon-Tfchelon in Nertfch-insk

insk; the beautiful rofe red variety at Mukla in Leffer Afia, where it was difcovered by an intelligent traveller, our countryman Mr Hawkins: alfo in Pegu and Ceylon. In Europe, in Bohemia at Schlackenwald, Zinnwald and Heinrichgrün; in Saxony at Scheckenftein, Altenberg, Zinnwald, Eibenftock, Ehrenfriederdorf and Geier; in Cornwall in England

Obfervations.

1. When colour was confidered as affording the moft certain means of diftinguifhing the precious ftones from each other, many different foffils were affociated with the topaz; and varieties of topaz were defcribed as diftinct fpecies. Thus the yellowifh white fapphire was termed oriental topaz, yellowifh rock cryftals Bohemian or occidental topaz; chryfolite was alfo confidered as a variety of topaz: on the other hand, the greenifh varieties of topaz were named aqua marine, and the blue, fapphire.

2. The topaz of the ancients is confidered by Werner to be our chryfolite.

3. The Saxon topaz is reckoned by jewellers to have the moft fire.

4. In the collection of the mufeum of natural hiftory at Paris, there is a Brazilian topaz which weighs 4 ounces 2 gros.

SEVENTEENTH SPECIES.

Emerald.

Schmaragd.—*Werner*.

Gemma pellucidiffima. Smaragdus, *Wall.* t. 1, p. 253.—Emeraude du Perou, *R. d. L.* t. 2. p. 245.—Schmaragd. *Wern. Cronft.* p. 102. *Ib. Wid.* p. 271.—Emerald, *Kirw.* vol. 1. p. 247 —Smaragd. *Eftner.* b. 2. p. 132.—Smeraldo, *Nap.* p. 122. *Lam.* t. 2. p. 227. *Brochant.* t. 1. p. 217.—Emeraude, verte *Hauy.* t. 2. p. 516.

External Characters.

Its characteriftic, and, we might almoft fay, its only colour, is emerald green, of all degrees of intenfity, from deep to pale. The deep fometimes inclines a little to verdegris green, and fometimes, and oftener, to grafs green: the pale varieties fometimes nearly pafs into greenifh white.

It is faid to occur maffive, and in rolled pieces, but of fuch Werner has feen no fpecimens; he has only obferved it cryftallized in

Low, equiangular, fix-fided prifms, which are 1ft, perfect; 2d, truncated on the lateral edges;

3d, truncated on the terminal edges; 4th, truncated on the terminal angles; 5th, terminal edges bevilled. When the truncations on the lateral edges increafe, a twelve-fided prifm is formed.

Cryftals middle fized and fmall, very rarely large; always implanted, and in drufes.

Lateral planes fmooth, terminal planes rough.

Internally the luftre is intermediate between fhining and fplendent, and is vitreous.

Fracture fmall and imperfectly conchoidal, yet it fometimes exhibits a concealed foliated fracture, having a fourfold cleavage, of which the folia are parallel with the lateral and terminal planes, as is the cafe with beryll.

Fragments indeterminately angular, and more or lefs fharp edged.

Alternates from tranfparent to tranflucent, and is duplicating tranfparent.

Hard, and little more than quartz, which it fcratches with difficulty.

Not particularly heavy.

Specific gravity—2,600, *Werner.*—2,775, *Brifson.*—2,7227 *to* 2,7755.—*Hauy.*

Chemical Characters.

Before the blow pipe it is difficultly fufible, but melts eafily with borax.

Constituent

Constituent Parts.

Silica	64,50		69
Alumina	16		15
Glucine,	13		12,50
Oxyd of Chrome	3,25		25
Lime	1,60		25
Water	2	Oxyd of Iron	1
	100,35		97,90
	Vauquelin.		*Klaproth.*

I. d. M. N. 38, p. 98.

Geognostic Situation.

It occurs in veins that traverse clay slate*. The accompanying fossils are calc spar, felspar, quartz and iron pyrites.

Geographic Situation.

At present it is only found in South America, and and there principally in the mountains of Popayan, and in the neighbourhood of de Manta, near to Puerto-Viejo, in Peru. The Romans are said to have procured it from Æthiopia and Egypt.

* Clay slate is usually known by the name primitive slate. Werner, for reasons which will be stated in the Geognosic, abolished the term primitive slate.

Use.

The colour which characterifes this foffil is extremely pleafing; the eye, after viewing the beautiful colours of the fapphire, oriental ruby, fpinelle and topaz, repofes with delight on the frefh and animating colour of the emerald, the charming emblem of the vegetable kingdom! It is rare, however, to find the colour pure and of good ftrength, hence fuch fpecimens are very highly valued, and are employed in the moft expenfive kinds of jewellery.

Obfervations.

1. Emerald and beryll have a ftrong refemblance to each other; thus both are green, their cryftallization differs but little, and fracture, hardnefs and weight are nearly the fame. Notwithftanding thefe agreements, Werner confiders them as well diftinguifhed from each other by the following characters: Emerald occurs only green, but beryll befides green is alfo yellow and blue; the cryftals of beryll are long, thofe of emerald are fhort; the lateral planes of beryll are ftreaked, thofe of emerald are fmooth; the terminal planes of beryll are fmooth, thofe of emerald are rough; beryll often prefents diftinct concretions, emerald never; beryll often fhews a formation by acicular fhoots, emerald never; beryll has tranverfe rents, emerald never.

2. Many

2. Many of the emeralds deſcribed by the ancients appear to have been varieties of gen fluor ſpar; even in more modern times, fluorſpar has been preſerved for emerald. Mr Coxe examined the famous emerald table in the abbey of Reichenau near Conſtance, which he found to be a very fine green coloured fluor ſpar. The famous ſacro cattino di ſmeraldo orientale, preſerved at Genoa, and which could only be ſeen by an order from the ſenate, appears to bea maſs of cellular glaſs. Many fine Æthiopian emeralds, which were bequeathed to monaſteries, appear to have been ſold by the monks, and coloured glaſs ſubſtituted in their place.

3. Several mineralogiſts are of opinion that the true emerald was not known in Europe until after the conqueſt of Mexico and Peru by the Spaniards. The following facts, however, are in oppoſition to this conjecture. 1. In the mitre of Pope Julius the Second, which is now preſerved in the muſeum of natural hiſtory at Paris, there is a fine deep coloured emerald: as he died in 1513, and Peru was not diſcovered and conquered by Pizarro before 1545, it is highly probable that this emerald was brought from Africa. 2. Werner has in his poſſeſſion ſeveral antique emeralds, and Mr Hawkins informed the Abbe Eſtner that he had ſeen a necklace of emeralds, which was found among the ruins of Portici near Naples.

4. The Braſilian emerald is a variety of tourmaline.

5. It is one of the lighteſt and ſofteſt of the precious ſtones.

EIGHTEENTH

EIGHTEENTH SPECIES.

Beryll.

Berill.—*Werner.*

Werner divides this ſpecies into two ſubſpecies.

FIRST SUBSPECIES.

Precious Beryll.

Edler Beril.—*Werner.*

Smaragdus—Aqua marina et Smaragdus—Berillus. *Wall.* t. 1. p. 254.—Aigue marine deSiberie, *R. d L.* t. 2. p. 252. *Ibd. Born.* t. 1. p. 71.—Edler Beril. *Wern. Cronſt.* ſ. 100.—Beryl. *Kirw.* vol. 1. p. 248.—Ed. Beril. *Wid.* ſ. 274.—*Id. Eſtner*, b. 2. ſ. 197.—Berillo *Nap.* p. 125. *Id. Lam.* t. 2. p. 232.—Le Beril noble, *Broch.* t. 1. p. 220.

External Characters.

Its principal is green, from which it paſſes on the one ſide into blue, and on the other into yellow. It is

is commonly mountain and ſeladon green: from theſe it paſſes through apple green, aſparagus green, into oil green, and laſtly into honey yellow, which approaches to wine yellow. From the ſeladon green it paſſes into ſmalt, ſky, and, in rare inſtances, into azure blue. Berlin Blue

Almoſt all its colours are pale, ſeldom deep, and ſcarcely ever dark. Sometimes it has two colours at once, which alternate in layers, and ſometimes it is irideſcent.

It is cryſtallized in long equiangular ſix-ſided priſms, which are either perfect or truncated on the lateral and terminal edges and angles. The truncations of the terminal edges ſometimes become ſo large as to form ſix-planed acuminations, of which the apices are truncated. The cryſtals, owing to the different breadths of their lateral planes, ſometimes approach to trihedral, ſometimes to oblique tetrahedral priſms. When they have cylindrical, convex lateral planes, they are ſometimes acicular, ſometimes reed-like.

The cryſtals are ſometimes heaped on each other, the ſmaller ones being almoſt always uppermoſt, thus forming a ſhape like a tower; and, in other caſes, they are perforated in the direction of their axes.

Imbedded and implanted, and interſect one another, but are ſeldom ſingle.

Deeply longitudinally ſtreaked, but the truncating and terminal planes ſmooth.

Small, large, and very large.

Externally

Externally its luftre is fhining and gliftening; internally fhining, which fometimes paffes into gliftening and fplendent, and is vitreous.

Crofs fracture intermediate between uneven and fmall, and imperfectly conchoidal; longitudinal fracture foliated with a fourfold cleavage: three of the folia or cleavages are parallel with the lateral planes, and the fourth with the terminal planes; and the lateral and terminal cleavages generally interfect each other at right angles. The cleavage is often very imperfect.

Fragments indeterminately angular, more or lefs fharp edged.

The maffive is compofed of ftraight and thin columnar prifmatic diftinct concretions, which are formed by collections of prifms difpofed in different directions.

Commonly tranfparent, but fometimes paffes into tranflucent, and is flightly duplicating. The tranflucent variety has crofs rents.

Hard: fcratches quartz; nearly equal in hardnefs to topaz, with which the mountain green variety has been often confounded.

Eafily frangible.

Not particularly heavy.

Specific gravity.—26,500 to 27,590, *Werner*.—2,683 to 2,722, *Briffon*.

Chemical Characters.

Before the blow pipe it is difficultly fusible without addition, but with borax it melts easily.

Constituent parts.

Silica	69,50		68,0
Alumina	14,00		15,0
Glucine	14,00		14,0
		Lime	2,0
Oxyd of Iron	11,00		1
	98,0		100
	Rose.		*Vauquelin, I. d. M.* N. 43, p. 563.

Physical Character.

It becomes very electrical by rubbing.

Geognostic Situation.

It occurs imbedded in primitive rocks, also in veins. It is usually accompanied with quartz, felspar, garnet, mica, fluor spar, and topaz. At Schlackenwald it

occurs in veins along with tin ſtone, quartz, and ſteatite.

Geognostic Situation.

The moſt beautiful berylls are brought from Dauria on the frontiers of China, and the Brazils. They are alſo found in the Uralian mountains; in France, (where they have been conſidered as emerald) and in Saxony at Johanngeorgenſtadt. I ſaw in the cabinet of the Hon. Mr Greville, a ſix-ſided priſm of beryll, which he was told had been found in the upper part of Aberdeenſhire in Scotland.

Uſes.

When pure it is cut for ring ſtones and for necklaces. Its frequency, inferior hardneſs, and little fire, render it, however, of leſs value than many other of the precious ſtones.

Obſervations.

Hauy and Karſten from the emerald and precious beryll agreeing in cryſtallization and conſtituent parts, conſider them as varieties of the ſame ſpecies, but we have already ſhewn the fallacy of this opinion.

2. Beryll ſeldom or never contains chrome, hence it does not ſhew the fine emerald green colour which characteriſes the emerald.

3. It was well known to the ancients, who procured it from ſeveral places where it is at preſent found. Pliny has given a good account of it, yet in latter times his deſcription appears to have been forgotten, for we find it arranged with other precious ſtones, to which it had but little reſemblance; thus the blue varieties were denominated ſapphire, the green, aqua marine, and the yellow, topaz. About fifteen years ago, Werner obtained a complete ſuite of ſpecimens of this foſſil from Siberia, which enabled him to frame the preceding deſcription, and to ſettle it as a diſtinct ſpecies.

SECOND SUBSPECIES.

Schorlous beryll.

Schörlartiger berill.—*Werner*.

Weiſſer Stangenſchœrl, *W. Cronſt.* p. 169.—Schorl blanc priſmatique, *R. d. L.* t. 2, p. 420.—Schörlartiger berill, *Wid.* p. 276. — Shorlite, *Kirwan.* vol. 1, p. 286. *Eſtner.* b. 2. p. 207.—Sorlo bianco, *Nap.* p 152.——Lucolite, *Lam.* t. 2, p. 274.—Leucolite, et Pycnite, *Hauy*, t. 3, p. 236.—Le Beril ſchorliforme, *Broch.* t. 1, p. 124.

External Characters.

Its principal colour is ſtraw yellow, which paſſes into yellowiſh white, greeniſh white, aſparagus green, and ſulphur yellow. Some varieties poſſeſs a colour which is intermediate between peach bloſſom and roſe red, and it even verges on crimſon red: other varieties, as thoſe from Altenberg in Saxony, are marked with ſpots of a violet blue, which inclines to cherry red.

It occurs almoſt always maſſive, and cryſtallized in long ſix-ſided priſms, (which are probably truncated

on

on the terminal edges), generally imbedded and feldom difengaged.

Chryftals large and middle fized.

Externally and internally its luftre is fhining, approaching to gliftening and is refinous.

Crofs fracture imperfectly foliated; the longitudinal fracture fmall and imperfectly conchoidal.

Fragments indeterminately angular.

Compofed of parallel, thin, and ftraight prifmatic diftinct concretions, which are longitudinally ftreaked.

More or lefs tranflucent.

Hard in a middling degree, yielding to the file.

Brittle.

Uncommonly eafily frangible.

Not particularly heavy, approaching to heavy.

Specific gravity.—3,530, *Klaproth*.—3,514, *Hauy*.

Chemical Characters.

Before the blow pipe it is infufible without addition; with borax it melts into a pure tranfparent glafs

Conftituent

Constituent Parts.

Silica	46	50	36,8
Alumina	52	50	52,6
		Lime	3,3
Water	2		1,5
	101	100,0	94,2
	Bergman. Crells. Annal. 1784.	*Klaproth. Ibid.* 1788.	*Vauquelin.*

Geognostic Situation.

It is found imbedded in a bed compofed of quartz and mica, and probably alfo in gneufs.

Geographic Situation.

It is found in confiderable quantity at Altenberg in Saxony, Schlackenwalde in Bohemia, ; alfo in Moravia, where it cccurs imbedded in gneufs, and accompanied with lepidolite; and at Rabenftein in Bavaria*.

*Flurl's Bavaria, p. 252.

Obfervations.

Obſervations.

It was for ſeveral years conſidered to be a variety of ſchorl, and was named white priſmatic ſchorl by ſome, and ſchorlite by others. Werner diſcovered that it was a diſtinct foſſil, but ſo nearly allied to precious beryll as to form a ſubſpecies, which he named ſchorlous, from its ſtrong reſemblance to ſchorl. It is placed immediately before ſchorl, as it is the link which unites it with beryll.

2. The reddiſh coloured variety of Moravia was for ſome time conſidered to be cryſtallized lepidolite.

NINETEENTH SPECIES.

Schorl.

Schörl.—*Werner*.

Werner divides this ſpecies into two ſubſpecies: 1. Common ſchorl. 2. Tourmaline.

FIRST SUBSPECIES.

Common Schorl.

Gemeiner Schörl.—*Werner.*

Some of the varieties of bafaltes cryftallizatus, *Wall,* t. 1, p. 333.—Schwartzer-ftangen fchorl, *Wid.* p. 279.—Schorl, *Kirw.* vol. 1. p. 265.—Sorlo-nero, *Nap.* p. 146. —Tourmaline, *Lam.* f 2. p. 295.—Le fchorl noire, *Broch.* t. 1. p. 226.—Tourmaline noire.—*Hauy,* t. 3. p. 31.

External Characters.

Its colour is velvet black, of various degrees of intenfity.

It occurs often maffive and diffeminated, feldom in rolled pieces, and frequently cryftallized.

Its cryftals are three-fided prifms, with cylindrically convex lateral planes, and acuminated on both ends by three planes, which, on the one extremity are fet on the lateral edges, on the other, on the lateral planes.

The cryftals are moftly acicular: often alfo broken, forming with the fragments a peculiar kind of fragment ftone or breccia: and are imbedded. The lateral planes are longitudinally ftreaked, and alternate from fhining to gliftening.

R Internally

Internally its luſtre is intermediate between ſhining and gliſtening, and is vitreous.

Its fracture is intermediate between imperfectly conchoidal, and ſmall and coarſe grained uneven, and inclines ſometimes more to the one, ſometimes more to the other.

Fragments indeterminately angular.

It very rarely preſents coarſe and ſmall grained diſtinct concretions; ſometimes it occurs in very thin, thin, and but ſeldom in thick and ſtraight priſmatic diſtinct concretions. Theſe concretions are ſometimes ſo thin that they verge on the fibrous, and ſuch varieties are ſometimes parallel, but moſt frequently ſcopiformly divergent, and are ſometimes again collected into thick wedge-ſhaped concretions, which rarely paſs into coarſe and ſmall grained diſtinct concretions.

Opaque, but a little tranſlucent on the edges, when it paſſes into tourmaline.

Gives a grey ſtreak.

Hard, ſlightly inferior to quartz.

Very eaſily frangible.

Intermediate between not particularly heavy, and heavy.

Specific gravity—3,092, *Briſſon*. — 3,150, *Gerhard*.— 3,212, *Kirwan*.

Chemical Characters.

Before the blow pipe it melts pretty eaſily without addition into a blackiſh ſlag. Melted with borax it forms a greeniſh coloured glaſs.

Constituent

Constituent Parts.

			Maſſive.	Cryſtallized.
Silica	33,33		40	38
Alumina	40,83		25	20
Iron	20,41	Lime	15	20
Manganeſe	3,33	Oxyd of iron with Manganeſe	18	19
	97,90		98,0	97,0

Wieglib. Crells Beiträge, b. 1. 333. *Gerhard,* Deſſen Grund. einer neüen *Min. Syſt.* th. 1. ſ. 312.

Phyſical Characters.

By heating it exhibits poſitive electricity at one extremity, and negative at the other. Wiedenman remarks that when it begins to cool, the poſitive end becomes negative, and the negative poſitive.

Geognostic Situation.

It occurs in primitive rocks, principally in quartz and granite; with the former it conſtitutes a peculiar mountain rock*. It is found ſeldomer in gneuſs, and

* The natural hiſtory of the ſchorl rock will be detailed in that part of this work which treats on mineralogical geography.

 ſtill

ſtill ſeldomer in mica ſlate and clay ſlate. It occurs alſo in ſingle beds, and veins of the oldeſt formation, particularly tin veins.

Geographic Situation.

It is found in many places of Saxony, Bohemia, Bavaria, Switzerland, Spain, Hungary, Scotland, &c.

Obſervations.

1. It has been confounded with baſaltic hornblende, melanite, actynolite, tremolite, beryll, &c.

2. It was firſt found near the village of Schorlaw, in Saxony, whence it s name.

3. It differs from tourmaline in colour, degree of luſtre, fracture, tranſparency, and diſtinct concretions; alſo in its geognoſtic ſituation, for tourmaline occurs almoſt always imbedded and in ſingle cryſtals; on the contrary, ſchorl is uſually aggregated, and occurs in beds.

SECOND SUBSPECIES.

Tourmaline.

Tourmalin.—*Werner*.

Zeolites—Electricus turmalin, *Wall.* t. 1. p. 329.—Schorl transſparent rhomboidal, *R. d. L.* t. 2. p. 344.—Braſilianischer turmalin, *Wid.* p. 284.—Tourmaline, *Kirw.* t. 1. p. 271.—Sorlo braſiliano, *Nap.* p. 150.—Tourmaline, *Lam.* t. 2. p. 295.—Le Schorl electrique, t. 1. p. 229.—Tourmaline-vertes et bleues, *Hauy*, t. 3. p. 31.

External Characters.

Its principal colours are green and brown: from leek green it paſſes into piſtacio and olive green, then into liver brown, and yellowiſh and reddiſh brown, further into hyacinth red, crimſon red, violet blue, azure blue, dark Berlin blue, and, laſtly, into indigo blue.

Its colours are almoſt all of them dark, often a little muddy, and when it is nearly opaque, on account of the darkneſs of the colour, it appears black.

It occurs very ſeldom maſſive, oftener in rolled pieces, but moſt frequently cryſtallized.

Its fundamental cryſtallization is an equiangular three-ſided priſm, and this is either perfect or has cylindrical convex lateral planes, and is flatly acuminated on both extremities by three planes, which, on the one extremity are ſet on the lateral edges, but on the other, on the lateral planes. The angles, edges, and extremities of the acumination are often truncated, and the edges ſometimes bevilled. When ſeveral of theſe alterations occur at the ſame time, the cryſtal has a very irregular aſpect, and is ſomewhat difficult to determine. The lateral edges are frequently bevilled, and thus is formed a nine-ſided priſm, in which three and three planes meet under two obtuſe angles. When the edges of the bevilments are truncated, a twelve-ſided priſm is formed; but when the bevilling planes increaſe ſo much that the original faces diſappear, an equiangular ſix ſided priſm is formed.

Priſms are generally long, thin, and needle-ſhaped; ſometimes they are alſo ſhort and thick; in other varieties, although very rarely, the acuminations meet together, when a double three ſided pyramid is formed, and the remainder of the priſm forms truncations on the edges of the common baſis *.

The lateral planes are generally ſtrongly longitudinally ſtreaked; the acuminating planes are moſtly

* Count de Bournon deſcribes a ſpecimen in the collection of Sir John St Aubyn, in which the priſm is completely wanting, and is, what he conſiders to be, the primitive figure of the tourmaline. *London Philoſophical Tranſactions for* 1802.

ſmooth

ſmooth and ſhining: ſometimes the planes on one extremity are ſmooth, but on the other rough.

The cryſtals are ſeldom large, more commonly middle ſized and ſmall, and ſometimes ſcopiformly aggregated, as is the caſe with the red variety from Siberia.

They are uſually imbedded.

Internally its luſtre is ſplendent and vitreous.

Croſs fracture has a tendency to foliated, and the folia appear to be a little inclined to the axis; longitudinal fracture is perfectly conchoidal, particularly in the tranſlucent varieties.

When it verges on common ſchorl it preſents priſmatic concretions.

It alternates from nearly opaque to completely tranſparent.

Some varieties, when viewed in a direction oblique to the axis of the cryſtal, are tranſparent, but in the direction of the axis opaque: others again exhibit different colours according to the direction in which they are held *.

Hard, but in a higher degree than quartz.

Eaſily frangible.

Intermediate between not particularly heavy, and heavy.

Specific gravity—Green tourmaline 3,086, *Werner*.—3,086, *Briſſon*.—From 3,0863 to 3,3626, *Hauy*.——Blue tourmaline 3,155, *Werner*.—3,130, *Briſſon*.

* Werner has in his poſſeſſion a tourmaline which is ſky blue in the middle, but violet blue on the ſides.

Chemical

Chemical Characters.

Before the blow pipe it melts into a greyiſh white veſicular enamel.

Conſtituent Parts.

	Tourmaline of Ceylon.	Of Brazil.
Silica	37,0	40,0
Alumina	39,0	39,0
Lime	15,0	3,84
Oxyd of iron	9,0	12,50
—— of manganeſe		2
	100	97,34
	Bergman,	*Vauquelin,*

Phyſical Characters.

By friction and heating it exhibits ſigns of poſitive and negative electricity. When it is cooled the extremities change their electricity. When it is heated beyond 200° of Fahrenheit, it is deprived of its electrical properties. The more tranſparent varieties appear to poſſeſs the ſtrongeſt electrical properties.

Geognoſtic

Geognoſtic Situation.

It occurs imbedded, and uſually in primitive rocks, as gneuſs, mica ſlate, clay ſlate, and granite.

Geographic Situation.

It was firſt found in the iſland of Ceylon, in the 16th century; afterwards in Brazil, and ſince that period in ſeveral other countries, as Madagaſcar, kingdom of Ava, Siberia, Spain, Switzerland, Tyrol, France, Saxony, Scotland, near Banff, Sweden, Norway, and Greenland.

Uſe.

It is ſometimes cut and poliſhed and worn as a jewel; but, on account of the muddineſs of its colours, it is not in general very much eſteemed.

Obſervations.

1. The green coloured tourmaline has been deſcribed by ſeveral mineralogiſts as emerald, the blue as ſapphire, and the crimſon red variety, which was firſt found in Siberia, and ſince in the kingdom of Ava, by Colonel Symes, and in the ſand of Ceylon,

by Count de Bournon, under the names daurite, fibcrite, and rubellite.

2. In the collection of the Hon. Mr Greville there is a most magnificent specimen of the red variety, which was presented to Colonel Symes by the king of Ava. It is undoubtedly the finest specimen of this fossil that exists in any cabinet, and stands pre-eminent among the riches of Mr Greville's great collection *. A particular description of it is given by Count de Bournon, in his Memoir on Corundum.

In the beautiful collection belonging to Baron Racknitz at Dresden, I observed a three-sided prism of the red variety, near an inch in diameter, and an inch and half long, which cost 400 rubles.

* It is valued at 1000l.

TWENTIETH SPECIES.

Thumerſtone.

Thumerſtein.—*Werner.*

Schorl tranſparent lenticulaire, *R. de L.* t. 2. p. 353.—Glaſs ſchorl, or Glaſtein, *Wid.* p. 294.—Thumerſtone, *Kirw.* vol. 1. p. 273.—Glaſtein, *Klapr.* b. 2. p. 118.—Tumite, *Nap.* p. 158.—Janolite, *Lam.* t. 2. p. 316. La pierre de Thum. *Broch.* t. 1. p. 236.—Axinite, *Hauy.* t. 3 p. 22.

External Characters.

Its moſt common colour is clove brown, of various degrees of intenſity; from that it paſſes on the one ſide into plumb blue, on the other into pearl grey, aſh grey, and greyiſh black.

It is ſeldom found maſſive, oftener diſſeminated, but moſt frequently cryſtallized.

1. In very flat and very oblique rhombs, in which the two oppoſite obtuſe lateral edges are generally truncated.
2. Often the rhomb is ſo flat that it has a tabular aſpect, and ſometimes cryſtals of this

figure interfect one another and form a cellural ſhape. The truncating planes are ſmooth, but the others are ſtreaked.

Externally its luſtre is generally ſplendent; internally it alternates from gliſtening to ſhining, and is vitreous.

Fracture fine grained uneven; in the tranſlucent varieties it ſometimes approaches to ſplintery; in the tranſparent varieties, to ſmall and imperfectly conchoidal.

Fragments indeterminately angular ſharp edged.

The maſſive occurs in curved lammellar diſtinct concretions, whoſe ſurface is ſhining and ſtreaked.

It alternates from perfectly tranſparent to weakly tranſlucent.

Pretty hard, yielding to the file.

Very eaſily frangible.

Not particularly heavy, approaching to the heavy.

Specific gravity—From 3,213 to 3,300, *Hauy.*—3,295, *Kirwan.*—3,250, *Gerhard.*

Chemical Characters.

Before the blow pipe it melts eaſily, without addition, into a greeniſh white ſemitranſparent glaſs.—*Lelievre.*

Constituent

Constituent Parts.

Silica	52,70	44,0
Alumina	25,79	18,0
Lime	9,39	19,0
Oxyd of iron	8,63	14,0
—— of manganefe	1,0	4,0
	97,51	99,0
	Klaproth, t. 2. p. 126.	*Vauquelin*, *J. d. M.* N. 23.

Geognostic Situation.

It appears to be peculiar to the primitive mountains, where it occurs in veins and beds of the oldeſt formation. It is found imbedded in limeſtone.

Geographic Situation.

It was firſt found at Thum in Saxony, whence it has its name: it has been alſo obſerved in Dauphiny, where it is accompanied with quartz cryſtals, aſbeſt, actynolite, and common felſpar; alſo near to Barrege in the Pyrenees, imbedded in calc ſpar, in Cornwall, at Konigſberg in Norway, and in Siberia*.

* In the muſeum of the Univerſity of Edinburgh there are ſpecimens of maſſive thumerſtone, ſent by Dr Guthrie of Peterſburgh, and ſaid to be from Siberia.

TWENTY-

TWENTY-FIRST SPECIES.

Iron Flint.

Eifenkiefel.—*Werner.*

External Characters.

Its colour is yellowifh brown, which borders on liver brown, and fometimes a colour which is intermediate between blood red and brownifh red.

It occurs moft commonly maffive, but alfo cryftallized in fmall equiangular fix-fided prifms, which are acuminated on both extremities by three planes, that are unconformably-wife fet on the alternate lateral planes. There are often fmaller planes between the three large planes of the acumination, and thus a fix-planed acumination is formed.

The cryftals are implanted, and interfect one another.

Externally its luftre is fplendent, internally fhining, which fometimes verges on gliftening, and is intermediate between vitreous and refinous, but more inclined to the former.

Fracture imperfectly fmall conchoidal, which, in fome varieties approaches to uneven.

Fragments

A late analysis made by a celebrated German Chemist Buckholtz shews that the constituent parts of the yellowish brown variety of Iron flint contains

Yellowish brown

92 Silica
$5\frac{3}{4}$ Oxide of Iron combined with a small portion of manganese
1 Manganese
1 Volatile matter

Redish Brown

95 Silica
5 Oxide of Iron

$76\frac{5}{6}$ Silica
$2\frac{4}{6}$ Oxide of Iron
1 Volatile Matter
1/4 Alumina

Fragments indeterminately angular, not particularly ſharp edged.

It occurs almoſt always in ſmall grained diſtinct concretions, which approach ſometimes to the fine, and more rarely to the coarſe grained.

It is opaque and ſlightly tranſlucent on the edges.

Pretty hard, yielding to the file.

Somewhat difficultly frangible.

Not particularly heavy, approaching to heavy.

Geognostic Situation.

It occurs in iron-ſtone veins, and appears to be an intimate mixture of quartz and iron ochre,

Geographic Situation.

It is found at Eibenſtock and Altenberg in Saxony, and, Karſten ſays, alſo at Briſtol in England.

Obſervation.

It renders the iron ore, along with which it occurs, very difficult of fuſion.

TWENTY-SECOND SPECIES.

Quartz.

Quarz.—*Werner.*

Werner divides this ſpecies into five ſubſpecies, 1. Amethyſt, 2. Rock Cryſtal, 3. Milk Quartz, 4. Common Quartz, 5. Praſe.

FIRST SUBSPECIES.

This ſubſpecies is divided by Werner into two kinds, *a.* Common Amethyſt, *b.* Thick fibrous Amethyſt.

FIRST KIND.

Common Amethyst.

Gemeiner Amethyst.—*Werner.*

External Characters.

Its principal colour is violet blue of all degrees of intensity. It passes on the one side from dark violet blue, through plumb blue into clove brown, and a particular kind of brownish black; on the other side from pale violet blue through pearl grey, ash grey, greyish white, greenish white, olive green, into pistacio green, which latter is uncommonly rare.

In the massive varieties, several colours occur together, and these are disposed in stripes, or fortification-wise.

Besides massive it occurs in rolled pieces, in angular pieces, and very frequently crystallized.

In equiangular rather obtuse six-sided pyramids, which are generally double, and, when that is the case, are either perfect or truncated on the common basis, and the lateral planes of the one are set on those of the other.

The cryſtals always occur in druſes, and are commonly heaped on one another, or penetrate one another. They are middle ſized and ſmall.

The planes of the cryſtals are ſmooth.

Externally its luſtre is ſplendent, internally it paſſes from ſplendent, through ſhining, to gliſtening, and is vitreous.

Fracture paſſes from perfectly conchoidal into imperfectly conchoidal; alſo into uneven, and even into coarſe ſplintery. The firſt has the greateſt luſtre and greateſt tranſparency.

Fragments indeterminately angular and ſharp edged.

The maſſive is commonly compoſed of more or leſs perfectly ſtraight and thick priſmatic diſtinct concretions, which are obliquely tranſverſely ſtreaked, and, when free at the extremities ſhoot into cryſtals. Theſe diſtinct concretions are generally interſected by other fortification-wiſe bent lamellar diſtinct concretions, and the colour delineation arranges itſelf in the direction of theſe lamellar concretions.

Sometimes the priſmatic concretions, when they are very ſhort, (which is very ſeldom the caſe) approach to coarſe grained diſtinct concretions.

It alternates from completely tranſparent to tranſlucent.

Hard, yields to the file.

Brittle.

Pretty eaſily frangible.

Not particularly heavy.

Specific gravity—2,750.

Chemical

Chemical Characters.

Lampadius expofed it for four hours to the ftrongeft heat of a wind furnace, when it fuffered no other change but the lofs of its colour, and about one and a quarter per cent. of its weight *. According to Ehermann, when expofed to a ftream of oxygen gas, it lofes its colour and melts to a tranfparent ball.

Constituent Parts.

Silica	97,50
Alumina	0,25
Oxyd of iron	0,50
Trace of manganefe	
	98,25

Rofe, *Karften's Tabell.* f. 23.

Geognostic Situation.

It occurs fometimes in veins in primitive rocks, and fometimes in agate balls and kidneys in porphyry and amygdaloid. The veins in which it occurs are either proper veins, and then it occurs along with the fibrous kind on which it refts, or they are agate veins, of which it commonly makes the middle. When it

* Lampad. Saml. Pract. Chem. Abhandl. b. 1. f. 225.

occurs in balls and kidneys, it crufts their furface with beautiful cryftals.

Geographic Situation.

It is found abundantly in Saxony, as at Annaberg, Cunnerfdorf near Drefden, the Coralbrüche near Freyberg, at Schneeberg, Volkenftein, &c. alfo in the Harz, in the Uralian mountains, and in the Eaft Indies. The green variety is found in the county of Glatz in Silefia; alfo in the Palatinate, where it occurs in amygdaloid. The moft beautiful varieties are found at Catharinaburg in Ruffia.

Ufe.

It is cut into rings, feals, and boxes, but it is not highly valued.

Obfervations.

1. The green variety is the chryfolite of fome authors.

2. The oriental amethyft is fapphire.

3. It is fometimes covered with capillary cryftals of iron mica, and, when viewed in certain pofitions, appears red; this variety is named hair amethyft.

SECOND KIND.

Thick fibrous Amethyſt.

Dickfaſriger Amethyſt.—*Werner.*

External Characters.

It has generally a pretty dark violet blue colour, which when pale and light borders on pearl grey, and from this latter paſſes into milk and yellowiſh white.

It occurs only maſſive and in rolled pieces.

Internally its luſtre is gliſtening, paſſing into ſhining, and is vitreous.

It has a double fracture ; the principal fracture is thick fibrous, and is ſtraight, and ſcopiformly diverging fibrous, and it ſometimes paſſes into ſplintery, ſo that we may often conſider it as intermediate between thin fibrous and ſplintery ; the croſs fracture is imperfectly conchoidal, and ſometimes intermemediate between uneven and ſplintery.

Fragments indeterminately angular, ſometimes wedge-ſhaped, ſometimes ſharp edged.

It ſhews a diſpoſition to coarſe and angular grained diſtinct concretions, and they are ſo very intimately

mately grown together, that it is difficult to diſcover the faces of the concretions.

Commonly tranſlucent, but in ſome varieties approaching to tranſparent.

Hard.

Not particularly difficultly frangible.

It agrees in the remaining characters with the preceding kind.

Geognoſtic Situation.

It is found in agate veins, and is generally accompanied with common amethyſt. When both kinds occur together in the ſame vein; the fibrous is always the oldeſt, or adheres to the wall of the rent.

Geographic Situation.

Nearly the ſame as the former.

SECOND

SECOND SUBSPECIES.

Rock or mountain Cryftal.

Bergcryftal.—*Werner.*

Quarzum pellucidum criftallizatum, *Wall.* p. 226.—Criftal de roche, *R. d L.* t. 2. p. 70.—Berg cryftal, *Wern. Cronft.* p. 111. *Id. Wid.* p. 296.—Mountain cryftal, *Kirw.* p. 241.—Bergcriftal, *Emm.* b. 1. p. 217. *Ibid Eftner*, b. 2. f. 318.—Quarzo, *Nap.* p. 170.—Quartz, *Lam.* t. 2. p. 119.—Le Criftal de Roche, *Broch.* t. 2. p. 243.—Quartz, *Haüy*, t. 2. p. 406.

External Characters.

Its principal colour is white, it occurs often alfo brown. From fnow white it paffes into greyifh white, yellowifh white, and reddifh white; from greyifh white it paffes into pearl grey; from yellowifh white it paffes through pale ochre yellow, wine yellow, yellowifh brown, clove brown, which falls falls into red, into brownifh black; from yellowifh brown it paffes into orange yellow and hyacinth red. Of thefe colours, white and brown are the moft common; the clove brown is known by the name of

of ſmoke topaz. It is characteriſtic of this foſſil, that the yellow and brown colours are not unoften diſpoſed in ſtriped delineations.

If it occurs maſſive it is very rarely: often in rolled pieces, and very often in cryſtals. Its cryſtallizations are the following.

1. Equiangular ſix-ſided priſm, ſomewhat acutely acuminated on both ends, by ſix planes, which are ſet on the lateral planes.

2. When the priſm becomes ſhorter, a double ſix-ſided pyramid is formed, in which the lateral planes of the one are ſet on the lateral planes of the other, and the remains of the priſm form a truncation on the common baſis; or the truncation is entirely wanting.

3. The priſm is ſometimes ſo broad that it reſembles an equiangular four-ſided table of which the angles and edges are bevilled: Sometimes the lateral planes incline toward the ends; in ſome varieties one acuminating plane is very large in compariſon to the other: in others three planes in each pyramid become ſo large, that the others diſappear, when a double three-ſided pyramid is formed.

4. Sometimes in the double ſix-ſided pyramid three alternate planes in each pyramid become larger than the others, and thus a figure approaching to the cube is formed.

Sometimes

Sometimes we meet with twin cryſtals, where one cryſtal penetrates the other longitudinally, and the upper is larger than the under.

Cryſtals are from uncommonly large to ſmall, but are moſt commonly middle ſized and large. The priſms are always larger than the pyramids, are heaped on one another, and ſometimes the priſms are hollow, and contain drops of water. The pyramids are all around cryſtallized and imbedded.

Cryſtals of actynolite, rutile and fibres of amianth are ſometimes diſperſed through it.

The lateral planes of the cryſtals are tranſverſely ſtreaked, but the acuminating planes are ſmooth.

Externally, the cryſtals are generally ſplendent, the rolled pieces are only gliſtening, paſſing into glimmering; internally they are ſplendent and vitreous.

Fracture almoſt always perfectly conchoidal, ſeldom flat conchoidal, ſometimes ſo flat that it verges on the concealed foliated, and in ſome rare varieties it ſhews a complete concealed foliated fracture, and the folia are parallel with the planes of the ſix-ſided pyramid, or with the acuminating planes of the ſix-ſided priſm.

Fragments indeterminately angular, very ſharp-edged.

It extremely rarely occurs in granular and priſmatic diſtinct concretions.

It is always tranſparent*, and in certain directions duplicating.

Pretty hard, yielding to the file.

Pretty eaſily frangible.

Not particularly heavy.

Specific gravity—2,650, rock cryſtal from Madagaſcar, *Briſson.*—2,605, clove brown cryſtal, *Karſten.*—2,888, ſnow white tranſparent, from Marmeroſch, *Ibid.*

Chemical Characters.

Completely infuſible by the blow pipe, and, according to Lavoiſier, it remains unaltered even when expoſed to a ſtream of oxygen gas. Coloured rock cryſtal, if carefully expoſed to a gentle heat, loſes its colour, but retains its tranſparency.

Constituent Parts.

Silica	93,0
Alumina	6,0
Lime	1,0
	100

Bergman, Opuſc. vol. 2, p. 112.

* In tranſparent cryſtals we generally find their baſis and point of adherence nearly opaque.

A species of Rock crystal has lately
been analysed by Bucholz
that contained $99\frac{3}{6}$ Silica

Physical Character.

When two rock cryftals are rubbed together, they are phofphorefcent in the dark, and exhale a peculiar empyreumatic odour. Its inflammability has not been proved, although, from its oryctognoftic affinity to diamond, it is not improbable that it is an inflammable body. [illegible] of Mr Davy

Geognostic Situation.

It occurs in veins and drufes, and is almoft exclufively confined to primitive rocks, particularly granite and mica flate; it is alfo found, although rarely, in clay porphyry, and gypfum.

Geographic Situation.

It is found in abundance in the lofty Alps of Switzerland and Savoy, alfo in Hungary, Saxony, Cornwall in England, Scotland, ifland of Arran, where it lines granite drufes, alfo the mountain of Cairngorum in Aberdeenfhire, and Shetland iflands*.

* Mineralogy of the Scottifh ifles, vol. 2.

Ufe.

Use.

It is ufed as an article of jewellery and feveral of the varieties, particularly the wine and orange yellow, are much prized. Thofe from the mountain Cairngorum have been long admired on account of their purity and beautiful colour.

THIRD

THIRD SUBSPECIES.

Milk Quartz.

Milch Quarz.—*Werner*.

Rosen rother quarz. *Wid.* p. 301.—Rosy red quarz, *Kirw.* vol. 1, p. 245. — Milch quarz, *Emm.* b. 1. s. 136.— Quarz laiteux, *Lam.* t. 2, p. 123.—Quartz laiteux ou Quartz Rose, *Broch*, t. 1, p. 246.—Quartz-hyalin-laiteux, *Hauy*.

External Characters.

It has sometimes a milk white, but more commonly a rose red colour, which is of all degrees of intensity, and sometimes approaches to the flesh red. The rose red sometimes passes into crimson red, and from this into reddish white, and a kind of pearl grey, and lastly into milk white, which exhibits a yellowish light.

It occurs only massive*.

* Werner has never seen it crystallized.

Internally

Internally its luftre is fhining, and fometimes paffes to fplendent, and is vitreous, inclining a little to refinous.

Fracture more or lefs perfectly conchoidal.

Fragments indeterminately angular fharp edged.

Some varieties fhew a tendency to ftraight and thick lamellar diftinct concretions.

It is more or lefs femitranfparent, even approaching to tranflucent. The femitranfparent varieties have the greateft degree of luftre, and a conchoidal fracture; the lefs tranfparent have lefs luftre, and a fplintery fracture.

Pretty hard, yielding to the file.

Eafily frangible.

Not particularly heavy.

Other characters the fame as thofe of rock cryftal.

Conftituent Parts.

Werner fufpects that it is compofed of filica and oxyd of manganefe.

Geognostic Situation.

It is found conftituting beds, but never veins, in primitive mountains, and is faid by Flurl to form part of a Bavarian granite.

Geographic

Geographic Situation.

It was firſt diſcovered in Bavaria, afterwards in Sweden, Greenland, at Hohenſtein in Saxony, Siberia, and in the iſland of Coll, one of the Scottiſh Hebrides.

Uſe.

1. It is employed in jewellery. It takes a good poliſh, and when the colour is good the ornaments made of it are beautiful. When cut and poliſhed and of a good colour, it is ſold for ſpinelle, yet its deficiency in hardneſs, tranſparency, and fire is ſo great, that the deception is eaſily detected.

2. The milk white variety, when cut, opaleſces into wine yellow.

3. It loſes its colour by keeping, particularly if in a warm place.

FOURTH

FOURTH SUBSPECIES.

Common Quartz.

Gemeiner Quartz.—*Werner.*

Quartzum rude, *Wall.* t. 1, p. 220. — *R. d. L.* Gemeiner quarz. *Wid.* p. 300.—Quartz. *Kirw.* vol. 1. p. 242.——*Eſtner*, b. 2. ſ. 265.——*Id. Emm.* b. 1. ſ. 125.—Quarzo. *Nap.* p. 170. *Lam.* t. 2. p. 119.—Quartz-Hyalin amorphe, *Hauy*,—Le Quartz commune, *Broch.* t. 1, p. 248.

External Characters.

Its moſt common colours are white and grey. Of white the following varieties have been obſerved: ſnow white, greyiſh white, yellowiſh white, greeniſh white, and reddiſh white: from the greeniſh white it paſſes into a middle colour between verdigris green, ſeladon green, and apple green.

It occurs alſo brown, yellow, green, and red.

The varieties of grey are aſh grey, ſmoke grey, yellowiſh grey, blueiſh grey, and pearl grey. From the yellowiſh grey it paſſes into wax and honey yellow; from the pearl grey into fleſh red, which ſometimes approaches to blood and brick red, and further into

into hyacinth red, reddiſh brown, and pale cheſnut brown.

Of theſe colours, white and grey are the moſt frequent; next in frequency is red, the others are rare. Smoke grey is in ſome varieties ſo dark that it paſſes into greyiſh black.

It is found maſſive, diſſeminated, in blunt edged pieces, in roundiſh grains, and rolled pieces. Further it occurs in a great variety of external ſhapes, as reniform, ſpecular, cellular, and with impreſſions; of the cellular it preſents the following varieties, hexagonal, polygonal, and parallelly, double, and ſpongiform circularly cellular.

The polygonal cellular is either large or ſmall cellular. Of the cellular the polygonal, and parallelly circularly cellular are the rareſt.

With impreſſions it occurs in tables, cubes and pyramids.

It occurs alſo corroded, amorphous, and ſometimes ſtalactitical.

It occurs in true and ſuppoſititious cryſtals.

The true cryſtals are nearly the ſame with thoſe of the amethyſt and rock cryſtal; they unite both, only they are here leſs regular and more aggregated.

1. Six-ſided priſm acuminated on both ends by ſix planes. It is either fully cryſtallized on both extremities, and then it is imbedded, or only cryſtallized at one extremity, and then it adheres.
2. Simple ſix-ſided pyramid. The cryſtals of this figure are either ſimple, heaped on one another, or bud-ſhaped aggregated.

3. Double ſix-ſided pyramid, which is ſometimes aggregated in rows.

The priſm occurs of every ſize, from ſmall to very large; on the contrary, the pyramid occurs only from middle-ſized to very ſmall.

Surface of the cryſtals is the ſame as in rock cryſtal.

Of the ſuppoſititious cryſtals, the following are known.

1. Complete cube; originates from fluor ſpar (found at Schneeberg.)
2. Equiangular and equilateral octaedron; originates from fluor ſpar.
3. Oblique ſix-ſided table; originates from baryte.
4. Acute ſix-ſided pyramid; originates from calc ſpar.

Theſe cryſtals have a rough ſurface.

Externally the luſtre of the true cryſtals varies from ſplendent to gliſtening, the rolled pieces are glimmering, paſſing into dull.

Internally it is ſhining, which on the one ſide borders on ſplendent, on the other paſſes through gliſtening, and nearly approaches glimmering, and is vitreous.

Fracture coarſe and fine ſplintery, and imperfectly conchoidal. Some rare varieties ſhew a parallelly fibrous fracture, reſembling that of gypſum, and others a concealed foliated fracture.

Fragments indeterminately angular, and pretty ſharp edged.

Maſſive.

Occurs

Occurs moſt commonly unſeparated, but often alſo in priſmatic diſtinct concretions, which are ſtraight, thin, thick, and very thick, ſometimes wedge ſhaped, tranſverſely ſtreaked, and, in moſt caſes, more imperfect than amethyſt. It occurs but ſeldom in granular diſtinct concretions, and when it does, the concretions are almoſt always fine, ſeldom ſmall grained, and commonly intimately attached to each other: it very rarely occurs in large grained diſtinct concretions, and this only in the remarkable quartz from Oibena. The fine grained variety has a ſlaty texture, and in thin tables is flexible.

It is moſt commonly tranſlucent, ſeldom ſemitranſparent, and this latter only in the cryſtallized varieties; in the darker varieties it is only tranſlucent on the edges.

Pretty hard.

Brittle.

Not particularly difficultly frangible, more difficultly frangible than rock cryſtal.

Not particularly heavy.

Specific gravity—26,404, 26,546.

Chemical Characters.

It is infuſible without addition before the blow pipe, but when expoſed to a ſtream of oxygen gas, according to Ehrmann, it melts into a milk white porcellanous ball.

Geognostic Situation.

It occurs very abundantly in the mineral kingdom. It is found forming whole rocks, alſo in beds and veins, and is a conſtituent part of granite, gneuſs, mica ſlate, and ſandſtone, and alſo occurs in clay ſlate.

Geographic Situation.

It is very univerſally diſtributed.

Uſe.

It is employed in place of ſand in the manufactory of glaſs, alſo in the preparation of ſmalt, and as an ingredient in porcelain and different kinds of earthen ware. The variety known by the name Avanturine is cut for ring ſtones, and is ſometimes much prized.

Obſervations.

1. The variety called avanturine has a reddiſh brown colour, and is marked with points and ſpots that glimmer like gold. It is found in Bohemia and Arragon.

2. A.

Massive Quartz

97 Silica

1/2 Ferruginous Alumina

1 Water   Buchholz

2. A variety of felſpar has alſo been denominated avanturine.

3. The blood red variety of quartz, which is found in Spain, was formerly conſidered to be hyacinth.

4. Some varieties of quartz, when burnt, acquire a reddiſh colour, and are then not unlike avanturine.

FIFTH SUBSPECIES.

Praſe.

Praſem.—*Werner.*

Praſem. *Wern. Cronſt.* ſ. 116.—Lauchgrüner quarz, *Wid.* p. 301.—Praſium, *Kirw.* vol. 1. p. 249—*Id. Eſtner,* b. 2. ſ. 207. *Id. Emm.* b. 1. ſ. 103.—Quarzo verde di porro, *Nap.* p. 171.—La Praſe, *Broch.* t. 2. p. 252—Quarz-hyalin verd obſcur, *Hauy.*

External Characters.

Its colour is leek green, of various degrees of intenſity.

Occurs generally maſſive, ſeldom cryſtallized.

Its

Its cryſtallizations are, 1. ſix-ſided priſm, acuminated by ſix planes, like quartz. 2. Six-ſided pyramid, but this is rare.

Cryſtals ſmall, and middle-ſized, and have always a druſy ſurface.

Luſtre ſhining, approaching to gliſtening, and between reſinous and vitreous.

Fracture coarſe ſplintery, which ſometimes approaches to the imperfectly ſmall conchoidal.

Fragments indeterminately angular, more or leſs ſharp edged.

The maſſive varieties occur in cuneiformly thick, diverging, priſmatic, diſtinct concretions, and ſometimes in coarſe grained diſtinct concretions.

Surface of the concretions rough and tranſverſely ſtreaked.

Tranſlucent.

Hard.

Difficultly frangible.

Not particularly heavy.

Geognostic Situation.

At Breitenbrun it occurs in a mineral bed, which is compoſed of magnetic pyrites, iron pyrites, copper pyrites, lead glance, blende, quartz, calc ſpar, and common actynolite.

Phrase

98 Silica

1 Oxide of Iron

1/2 Alumina combined with Manganese

Geographic Situation.

It is found at Breitenbrun near Schwartzenberg, in the electorate of Saxony, and it is ſaid alſo to have been found in Finland and Siberia.

Uſe.

It is ſometimes cut and poliſhed for ornamental purpoſes.

Obſervation.

It is an intimate mixture of quartz and actynolite.

General Obſervations on the ſpecies Quartz.

It is one of the pureſt ſpecies of the flint genus; is the moſt abundant of foſſils; and occurs in almoſt every geognoſtic ſituation.

In the primitive mountains it forms an eſſential conſtituent part of ſeveral of the moſt mighty rock formations, as granite, gneuſs, and mica ſlate: it occurs alſo imbedded in porphyry, in great rocky maſſes, in beds, veins, and neſts; and either alone or accompanied with other foſſils.

In the tranſition rocks it forms a conſtituent part of grey wacce and of many veins.

It

In the floetz rocks it forms the principal conftituent part of the different great fandftone formations, and occurs alfo in the gyps and limeftone formations.

Even in the neweft of all the formations, the alluvial, it is found in boulders and as loofe fand.

Several varieties, as we have already mentioned, are by no means fo common; thus the quartz, with date-fhaped diftinct concretions, is only found in Silefia: the larger cellular variety only at Schneeberg in Saxony; the fmall cellular only in the Harz and Hungary; and laftly, the fine angular grained, flaty and flexible variety has been hitherto found only in the Brazils.

The picture of the quartz fpecies which has been defcribed in the preceding pages is one of the moft highly finifhed in the Wernerian oryctognofie. Wiedenman and other mineralogifts by attending only to a few of its leaft characteriftic features, have failed in underftanding it.

TWENTY-THIRD SPECIES.

Hornſtone.

Hornſtein.—*Werner.*

Werner divides this ſpecies into three ſubſpecies. 1. Splintery hornſtone. 2. Conchoidal hornſtone. 3. Woodſtone.

FIRST SUBSPECIES.

Le Hornſtein ecailleux, *Broch.* t. 1. p. 255.

External Characters.

Its moſt common colour is grey, frequently alſo red, but ſeldom of other colours. Of grey it preſents the following varieties; blueiſh, greeniſh, yellowiſh, ſmoke and pearl grey; from pearl grey it paſſes into fleſh red, ſometimes even into blood red and browniſh red, and from greeniſh grey it paſſes into mountain and olive green.

It is found moſt commonly maſſive, ſeldom in rolled pieces, and in large balls, and very ſeldom with pyramidal impreſſions of calc-ſpar.

Fracture ſplintery, generally fine ſplintery, and often with a ſlight inclination to conchoidal.

Internally its luſtre is dull; it is glimmering when it approaches to the nature of quartz.

Fragments indeterminately angular, more or leſs ſharp edged.

It is almoſt always unſeparated; the globular occurs in concentric lamellar diſtinct concretions.

It is more or leſs tranſlucent on the edges, and ſometimes it is in a ſlight degree tranſlucent.

Hard.

Brittle.

Very difficultly frangible.

Not particularly heavy.

Chemical Characters.

Infuſible without addition before the blow pipe. Some mineralogiſts aſſert that it is eaſily fuſible without addition; but their experiments appear to have been made with compact felſpar, which to an unexperienced eye might be miſtaken for hornſtone.

Geognostic Situation.

Found in veins, in the ſhape of balls, in limeſtone; and ſometimes forming the baſis of porphyry.

Geographic Situation.

It is found at Schneeberg, Freyberg, Johangeorgenſtadt, in veins; and globular in limeſtone in Bavaria. It is alſo found in Sweden, at Dannemora and Garpenberg, where it forms the baſis of porphyry; alſo in the Shetland iſlands, where it forms the baſis of porphyry*.

Obſervations.

It appears to differ from quartz in containing a greater proportion of alumina; when it contains a large quantity it paſſes into jaſper.

It ſometimes borders on chalcedony and flint.

* Mineralogy of the Scottiſh iſles, vol. 2.

SECOND SUBSPECIES.

Conchoidal Hornſtone.

Muſchlicher Hornſtein.—*Werner.*

Le Hornſtein conchoide, *Broch.* t. 1. p. 250.

External Characters.

It is commonly greyiſh white, yellowiſh white, greeniſh and pearl grey; from this it paſſes into fleſh red and cherry red, and from greeniſh grey it paſſes into mountain green.

It ſometimes exhibits ſpotted, ſtriped, and clouded delineations.

It occurs only maſſive.

Internally it is ſcarcely gliſtening, approaching to glimmering.

Fracture nearly perfectly conchoidal.

Fragments indeterminately angular, pretty ſharp-edged.

It never occurs in diſtinct concretions.

Strongly tranſlucent on the edges.

Hard.

Eaſily

Eafily frangible.
Not particularly heavy.

Geognostic Situation.

It occurs in beds; alfo in veins, accompanied with agate.

Geographic Situation.

It is found at the Friedlichen Vertrage at Goldberg in Saxony. Also in the Pentland hills.

Obfervations.

1. It is diftinguifhed from the preceding fpecies by the lightnefs of its colours, its conchoidal fracture, and its inferior tranflucency and hardnefs.

2. It feems to be allied to ribbon jafper.

THIRD

THIRD SUBSPECIES.

Woodſtone.

Holzſtein.—*Werner.*

Holzſtein, *Wid.* p. 329.—Woodſtone, *Kirw.* v. 1. p. 315. —Le bois petrifié ou le Holzſtein, *Broch* t. 1, p. 259.

External Characters.

Its moſt common colour is aſh grey, from this it paſſes into greyiſh black, which falls a little into yellow and brown, further into yellowiſh grey and pearl grey, and from this into fleſh red, blood red, and browniſh red. From the yellowiſh grey it paſſes into ochre yellow. It occurs alſo greyiſh white.

In general ſeveral colours occur together, and it commonly exhibits colour delineations, as clouded and ſtriped, and theſe arrange themſelves in the direction of the original woody texture.

Its ſhape is exactly conformable to its former woody ſhape, ſo that it ſometimes occurs in the form of trunk, branches, and roots. It ſhews often its former woody texture.

Sometimes

Sometimes found in rolled pieces.

External ſurface uneven and rough.

Internally it is ſometimes dull, ſometimes glimmering and gliſtening, according as it is more or leſs of the nature of the two preceding ſubſpecies.

Croſs fracture imperfectly conchoidal; longitudinal fracture ſplintery and fibrous.

Fragments indeterminately angular, not ſharp-edged.

Slightly tranſlucent, or tranſlucent on the edges,

Pretty hard, but not ſo hard as ſplintery hornſtone.

Eaſily frangible.

Not particularly heavy; lighter than ſplintery hornſtone.

Geognoſtic Situation.

It is found inſulated in ſandy loam.

Geographic Situation.

It is found in Saxony, Bohemia, Ruſſia, Hungary, and at Loch Neagh in Ireland, Siberia & other [illegible] Italy

Uſe.

It receives a good poliſh, and ſerves for the ſame purpoſes as agate.

Obſervation.

Obfervation.

At firft fight it may appear inconfiftent to confider a petrefaction as a particular foffil fpecies; when we reflect, however, that woodftone differs in its external characters from all other foffils, the juftnefs of the Wernerian method will become evident. Many other foffils occur in the fhape of petrefactions, but they are almoft always identical with fome known fpecies, and therefore are to be confidered only as varieties of the external fhape of the particular foffil to which they belong.

TWENTY-FOURTH

TWENTY-FOURTH SPECIES.

Flint.

Feurftein.—*Werner.*

Silex igniarius, *Wall,* t. o. p. 275.—Feurftein, *Wid.* p. 308 Flint, *Kirw.* vol. 1. p. 301.—Feurftein, *Eflner.* b. 2. f. 360. *Id. Emm.* b. 1. f. 143,—Pietra focacia, *Nap.* p. 180.—Silex ou Pierre a fufil, *Lam.* t. 1. p. 137. *Id. Broch.* t. 1, p. 263.—Quartz, agathe, pyromaque, *Hauy.*

External Characters.

Its moft common colour is grey, of which the following varieties occur: afh grey, yellowifh grey, and fmoke grey. From fmoke grey it paffes on the one fide through afh grey, into greyifh black; on the other into yellowifh grey, and a colour intermediate between ochre and wax yellow; further, into yellowifh brown, reddifh brown, and into a middle colour between blood red and brownifh red.

It fometimes prefents colour delineations, as zoned, ftriped and flamed.

Befides maffive, in regular plates, in angular grains and pieces; it occurs alfo in globular and elliptical

rolled pieces, in the form of ſand, and tuberoſe and perforated.

It ſometimes, although rarely, occurs in ſuppoſititious cryſtals. Theſe are,

1. Flat double three-ſided pyramid.

2. Six-ſided priſm, acuminated by three planes.

Theſe cryſtals are internally hollow, and are derived from calc-ſpar.

Occurs in extraneous external ſhapes, viz. in the form of echinites, corallites, &c.

The external ſurface of the angular pieces is ſmooth and gliſtening, that of the other ſhapes is ſometimes rough, ſometimes uneven.

Internal luſtre glimmering.

Fracture perfectly conchoidal.

Fragments indeterminately angular, and ſometimes tabular, and very ſharp edged.

Generally unſeparated, ſometimes occurring in lamellar diſtinct concretions.

Tranſlucent, the blackiſh varieties ſeldom more than tranſlucent on the edges.

Hard, a little more than quartz.

Eaſily frangible.

Not particularly heavy.

Specific gravity—2,594, *Blumenbach*—2,581, *Geller*.

Chemical

Chemical Character.

Before the blow pipe it is infufible without addition.

Constituent Parts.

Silica	98,0	97,0
Lime	0,50	
Alumina	0,25	1,0
Oxyd of Iron	0,25	
Lofs	1,00	2,0
	100	100
	Klaproth.	*Vauquelin.*

Geognostic Situation.

It is almoft exclufively confined to the Floetz mountains; there it occurs in beds, or imbedded in limeftone and chalk. In the alluvial land it is found only in rolled pieces, and in the primitive mountains in fmall quantity in veins.

Geographic Situation.

It is found in the Danifh iflands of Rugen and Zeeland; in Spain; in France, where it occurs of a beautiful

beautiful brown colour; at Mufkaw in Lufatia; in agate balls in the Pfalz; in England in great abundance; the north of Ireland, and very rarely in Scotland. Brochant informs us that in the fouth of France hollow globular flint is found, which contains fulphur in its interior, vol. 1, p. 267.

Ufes.

Great quantities of it are manufactured into gun flints, and it is often employed in the place of quartz in the manufactory of glafs, porcelain and fmalt.

Obfervations.

1. The mode of formation of imbedded flint, has been a fubject of confiderable controverfy, and many different explanations have been propofed. The moft probable, and the only explanation we fhall at prefent mention, is that which was firft propofed by Werner, viz. 'that during the depofition of chalk, air was 'evolved, which, in endeavouring to efcape, formed 'irregular cavities, that were afterwards filled up, by 'infiltrations, with flint'.

2. It is often covered with a whitifh cruft, which is moft ufually produced by weathering: in other inftances appears to be an original formation.

TWENTY-SIXTH

TWENTY-FIFTH SPECIES.

Chalcedony.

Calezdon.—*Werner.*

Werner divides this ſpecies into two ſubſpecies, 1. Chalcedony, and 2. Carnelian.

FIRST SUBSPECIES.

Common Chalcedony.

Gemeiner Calzedon.—*Werner.*

Achates chalcedonius, *Wall.* t. 1. p. 298. — Calcedoine, *R. d. L.* t. 2. p. 145.—Gemeiner chalzedon, *Wid.* p. 317. Common chalcedony, *Kirw.* vol. 1. p. 298.—Chalcedon, *Eſtner*, b. 2. f. 368. *Id. Emm.* b. 1. f. 151.—Calcedonia, *Nap.* p. 183.—La Calcedoine, *Lam.* t. 2. p. 142. *Id. Broch.* t. 1. p. 268.—Quartz, agathe, calcedoine, *Hauy.*

External Characters.

Its moſt common colour is grey, of which the following varieties occur: ſmoke grey, blueiſh grey, pearl grey, greeniſh grey, and yellowiſh grey. The blueiſh grey paſſes into milk white and ſmalt blue; the greeniſh grey into a colour which is intermediate between graſs and apple green; the yellowiſh grey paſſes into honey yellow, wax yellow, and ochre yellow; from this into yellowiſh brown, blackiſh brown, and browniſh black.

The two laſt mentioned colours are very dark, and when held between the eye and the light appear blood red.

The

The green and blue varieties are the rareſt.

White and brown ſtripes often alternate with each other, and form the variety named onyx.

The milk white variety is known by the name cachalong.

The grey varieties with thick priſmatic diſtinct concretions, when tranſverſely cut, and held between the eye and the light, exhibit rainbow colours, and hence have been named rainbow chalcedony.

When it is cut parallel to the diſtinct concretions, it exhibits a clouded delineation.

External ſhape very various; beſides maſſive, in blunt edged pieces, grains and rolled pieces, it occurs in original round balls (which are found in Amygdaloid, and often filled with water) reniform, botroidal, coralloidal, ſtalactitical; alſo cryſtallized in cubes?

Alſo found in extraneous external ſhapes, as in turbinites, tubulites, &c.

Internally almoſt always dull; ſome rare varieties exhibit a very faint degree of luſtre.

Fracture perfectly even; it paſſes ſometimes, however, into fine ſplintery, alſo into the uneven, which approaches to the imperfectly flat conchoidal. The latter variety has a ſlight degree of luſtre.

Fragments indeterminately angular, and pretty ſharp edged.

Generally occurs in reniform and fortification-wiſe curved lamellar, uſually concentric, diſtinct concretions, which are commonly very thin, and have a rough and dull ſurface.

Commonly

Commonly ſemitranſparent; but the black and white varieties only tranſlucent.

Hard, and rather more more ſo than flint,

Brittle.

Somewhat difficultly frangible.

Not particularly heavy.

Specific gravity — 2,600 to 2,655, *Kirwan.* — 2,586, *Briſſon.*—2,615, *Blumenbach.*

Chemical Character.

Infuſible before the blowpipe without addition.

Conſtituent Parts.

Silica	84
Alumina	16

Bergman. Opuſcul. 2. p. 60.

Geognoſtic Situation.

Occurs moſt commonly in balls, in amygdaloid, alſo in angular pieces and veins, in porphyry and amygdaloid. When it occurs in veins it is often ſtalactitical, reniform, and coralloidal*.

* The coralloidal variety is found in veins in Cornwall.

Geographic

Geographic Situation.

The cubic variety occurs in Tranſilvania, and the other varieties in Iceland, Feroe iſlands, Sileſia, Saxony, Siberia, Cornwall, Scotland, iſlands of Egg, Rume*, &c.

Uſes.

As it is ſuſceptible of a fine poliſh it is employed as an article of jewellery.

Obſervations.

1. The name of this ſpecies is derived from the province of Chalcedon, in Aſia, where it was firſt found.

2, Onyx, on account of the high poliſh which it is capable of receiving, is very much prized, and is conſidered as the moſt valuable variety of this ſpecies. It is principally cut in bas relief work, and the fineſt ſpecimens for that purpoſe are brought from the Eaſt Indies.

3. The dendritic variety is named Mocha ſtone, becauſe it was ſuppoſed to have been originally brought from Mocha in Arabia. Veltheim, however, informs

* Mineralogy of the Scottiſh iſles, vol. 2.

us that no ſtone of this kind is found near Mocha, and affirms that mocha is a corruption of the German word mochs, which ſignifies moſs. It is the next in value to the onyx.

4. The cubic appears rather to be a variety of milk quartz, than of chalcedony, as it agrees with it in fracture, luſtre and colour.

SECOND SUBSPECIES.

Carnelian.

Karniol.—*Werner.*

Achates carneolus, *Wall.* t. 1. p. 185.—Cornaline, *R. de L.* t. 2. p. 146.—Blutrothe kalzedon, *Wid.* p. 318 —Carnelian, *Kirw.* vol. 1. p. 3 00 Karniol, *Emm.* b. 1. f. 357.—Carniola, *Nap.* p. 185.—Agathe cornaline, *Lam.* t. 2. p. 147.—La Cornaline, *Broch.* vol. 1. p. 272. —Quartz-agathe.cornaline, *Haüy.*

External Characters.

Its principal colour is blood red, of all degrees of intenſity, (the deepeſt ſhade falls into brown, and

ſome approach to yellow and others to white), from this it paſſes into fleſh red, reddiſh white, milk white, and into a kind of yellow. Some varieties approach to the reddiſh brown.

It ſometimes preſents zoned and dendritic colour delineations.

The white variety ſometimes alternates with ſtripes of a reddiſh colour.

It has uſually a reddiſh brown coloured cruſt.

It commonly occurs in roundiſh pieces, and alſo in layers in agate.

External ſurface rough and uneven.

Fracture perfectly conchoidal.

Luſtre gliſtening, bordering on glimmering.

Fragments indeterminately angular and very ſharp-edged.

Moſt commonly unſeparated, yet in ſome varieties it ſhews a tendency to concentric and fortification-wiſe bent lamellar diſtinct concretions, and according to the diſpoſition of theſe the colour delineations are formed.

Semitranſparent, and agrees with common chalcedony in other characters.

Geognostic Situation.

It is found accompanying agate, and, in general, has the ſame geognoſtic ſituation as Chalcedony.

The fine oriental varities occur in rolled pieces.

Geographic

Geographic Situation.

The moſt beautiful carnelian is brought us from Arabia, and Surat and Cambay in Hindoſtan. It is alſo found in different parts of Europe.

Uſe.

It it uſed for ſeals, bracelets, croſſes, and other ornaments.

Obſervations.

1. The oriental carnelian is far handſomer than that which is found in Europe; the blood red colour of the European is impure and muddy, ſo that it does not receive ſo good a luſtre and poliſh as the Indian.

2. The white variety, which alternates with ſtripes of red, and alſo the arboreſcent are by Cronſted named Sardonyx: although they are very different from the ſardonyx of the antiquary. Werner in this follows Cronſted.

3. The name is derived from its colour, as it was conſidered to reſemble fleſh.

4. Werner ſuppoſes that the red colour is not original, but has been produced by the infiltration of an irony matter.

Agate.

Agate.

The foffils known by the name Agate are all compound, therefore are more properly objects of geognofie than oryctognofie. Werner, however, has placed them in his oryctognoftic fyftem as an appendix to the fpecies chalcedony, probably on account of their occurring in inconfiderable quantity, and from chalcedony forming their principal conftituent part.

They are compounded of chalcedony, carnelian, jafper, hornftone, quartz, heliotrope, amethyft, indurated lithomarga, and opal. Thefe different foffils do not occur in every agate, moft commonly only two or three, a circumftance which affords us a bafis for an arrangement of them according to their conftituent parts. Such an arrangement, however, would be very difficultly accomplifhed; hence Werner has preferred the eafier method of difpofing them according to their colour delineations. Thefe delineations are formed by the manner of junction of the different foffils.

The following are the different kinds of agate mentioned by Werner: 1. Fortification agate. 2. Landfcape agate. 3. Ribbon agate. 4. Mofs agate. 5. Tube agate. 6. Clouded agate. 7. Zoned agate. 8. Star agate. 9. Fragment agate. 10. Punctated

tated agate. 11. Petrefaction agate. 12. Coral agate, and 13. Jasper agate.

1. Landscape agate, appears to be composed of jasper, chalcedony, and hornstone.
2. Ribbon and zoned agate, are to be considered the same, the difference in colour delineation being produced by the particular direction in which the stone is cut. When it is cut perpendicular or oblique to the layers of which it is composed, ribbon agate is formed; but, when parallel with the layers, we obtain zoned agate. It is formed by the disposition of the layers on a pyramidal inequality, which is generally quartz.
3. Moss agate. Here jasper of various colours, as brown, yellow, &c. appears swimming in a chalcedonic basis. The jasper resembles moss, and when its arborarations are distinct is very beautiful. Its mode of formation appears to be different from the preceding; according to Werner it has been formed more by a kind of gelatinisation, than by a successive deposition.
4. Tube or tubular agate, is composed of tubes of chalcedony and carnelian, and sometimes jasper, which are commonly filled with another fossil. When it is cut transversely it exhibits a circular or zoned delineation, but the zones are not so distinct as in the zoned agate, and the circle is produced

produced by a tranfverfe, uot by a perpendicular fection, as is the cafe with the zoned agate. It is found in the manner of ftalactite.

6. Clouded agate. The clouded markings are not fharp, and the colours run into each other. Its mode of formation is probably the fame with the mofs agate.

7. Star agate and coral agate, are to be confidered as intermediate kinds between zoned and fortification agate.

8. Punctated agate. In this, which is one of the moft beautiful fpecies, points of jafper having various colours, as red, yellow, brown, &c. are difperfed through a chalcedonic bafis. The red points in heliotrope are not effential to it, therefore it does not belong to this fpecies.

9. Petrefaction agate. This is wood penetrated with feveral of the foffils that conftitute agate.

10. Fragment agate. This beautiful variety is compofed of fragments of different kinds of agate or of chalcedony, carnelian, &c. cemented by a fine flinty bafis.

11. Jafper agate. Jafper, which in this variety is the principal conftituent part, is intermixed with chalcedony. It has fometimes, alfo, filver interfperfed.

Formation of Agate.

As the explanation of the modes of formation of the different kinds of agate, given by Werner, is interesting, I shall here give a short statement of it.

First, respecting those kinds that occur in amygdaloid: He supposes, that during the deposition of amygdaloidal rocks, a considerable quantity of air was evolved, which, in endeavouring to escape, formed cells, into which siliceous matter passed by infiltration, and formed agate. These cells, he supposes, were filled, not by one, but from several successive stony solutions, which deposited their contents, and thus formed thin coats of jasper, carnelian, chalcedony, &c. The inspection of these agates shews, that the first precipitate has been the coarsest, but that the successive ones have continued to increase in fineness until out of the last or finest solution amethyst has shot, or when it has had room enough has crystallized. That the solution out of which these precipitates took place was truly chemical, is shewn, not only by the appearance of the substances themselves, but also by the mode of their deposition, as they follow accurately the inequalities on the surface of the cavities, so that an elevation on the interior wall continues to be observed through all the superincumbent coats to the centre. When specimens of this kind are cut in

a

a proper direction, we can always obferve the opening by which the folution has entered*.

Ribbon agate is formed in veins, and has been formed by depofition from different folutions.

The mode of formation of breccia or fragment agate is different from that of either of the preceding. If a completely formed agate vein is (again) rent, it is eafily conceivable, from the great brittlenefs of the ftone of which it is compofed, that many pieces would break off, and fall into the numerous openings thus formed. A new folution being poured into thefe rents would fill them up, and connect together all the fragments, and thus a brecciated agate would be formed.

In a fimilar manner are formed the fmaller and greater angular lengthened drufy cavities of quartz and amethyft, that occur in agate.

Similar rents, but on a fmaller fcale, are to be obferved in ribbon agate, and thefe are generally filled with quartz and amethyft.

* Many objections have been oppofed to this explanation, but the only one worthy of notice is the following. If the cavities have been filled by infiltration, it is demanded, how can we explain the efcape of the water after the depofition of the ftony matter? To this it may be anfwered, that as foon as the diffolved matter was depofited, the water which held it in folution, from its lefs fpecific gravity, would be difplaced by the heavier new folution, and efcape by the infiltration opening.

Geographic Situation.

No country affords finer agates, or in greater abundance than Germany: It would be ufelefs to mention all its German localities; it is fufficient to obferve, that it is found in great quantity at Ober-ftein, where feveral thoufand perfons are employed in quarrying, forting, cutting and polifhing it. It is alfo found in France, England, Scotland, and Ireland, and very beautiful in the Eaft Indies, where, however, it is confounded with onyx.

Ufe.

Its ufes are very various; fometimes it is cut into vafes, mortars, fnuff boxes, fometimes into plates for inlaying in tables; when it is very handfome it is ufed for feal ftones, and then it is ufually fet with a blue or gold foil; and the fmaller pieces are ufed for gun flints, for which it is often excellently fuited.

It was highly valued by the ancients, who executed many fine works in it, which are now never attempted. It is only in the cabinets of the rich that fuch pieces of ancient work are to be feen; the collections of Brunfwick and Drefdenar remarkable for beautiful fpecimens of this kind.

TWENTY-

TWENTY-SIXTH SPECIES.

Heliotrope.

Heliotrop.—*Werner.*

Jaſpis variegata, heliotropius, *Wall.* t. 1, p. 315.—Heliotrop, *Wid.* ſ. 316.—Heliotropium, *Kirw.* vol. 1. p. 314. *Eſtner,* b. 2. ſ. 389. *Id. Emm.* b. 1. ſ. 171.—Eliotropio, *Nap.* p. 193.—Jaſpe ſanguin, *Lam.* t. 2. p. 166.—L'Heliotrope, *Broch.* t. 1. p. 276.—Quartz—agathe, verd obſcur & quartz—jaſpe ſanguin, *Hauy.*

External Characters.

Its principal colour is intermediate between leek and dark ſeladon green, or mountain green, and is always deep. Some varieties paſs from leek green nearly into piſtacio and olive green; others are marked with blood and ſcarlet red, alſo with ochre yellow and yellowiſh brown ſpots of jaſper.

It occurs maſſive, in angular pieces, and rolled pieces.

Internal luſtre is gliſtening, and nearly reſinous.

Fracture imperfectly large conchoidal.

Fragments indeterminately angular and ſharp edged.

It is commonly tranſlucent on the edges, ſome varieties even paſſing into tranſlucent.

Eaſily frangible.

Hard.

Not particularly heavy.

Specific gravity—2,633, *Blumenbach*.—2,620 to 2,700, *Kirwan*.

Geognostic Situation.

It is found in rocks belonging to the floetz trap formation, and probably occurs in the ſame kind of repoſitory as chalcedony.

Geographic Situation.

In Aſia, it is found in Bucharia, Perſia, and Siberia; in Europe, it has been diſcovered in Iceland, and alſo in Upper Saxony.

Uſes.

Its beautiful colour and conſiderable hardneſs cauſe it to be employed for nearly the ſame purpoſes as agate. That which has the greateſt degree of tranſlucency and moſt numerous red points, is the moſt highly valued.

Obſervation.

Obſervation.

Werner is of opinion that it is an intimate combination of chalcedony with green earth.

TWENTY-SEVENTH SPECIES.

Plaſma.

Plaſma.—*Werner.*

Id. E*mm*. b. 3. ſ. 322. *Id. Broch.* t. 1. p. 278.

External Characters.

Its moſt common colour is intermediate between graſs and leek green, and of different degrees of intenſity; ſometimes it approaches to mountain green. It is marked with ochre yellow dots and whitiſh ſpots. The white ſpots are very characteriſtic of this ſpecies.

Occurs in indeterminately angular pieces, which have a rough earthy cruſt.

Internally

Internally its luftre is gliftening, verging on glimmering *.

Fracture perfectly flat conchoidal.

Fragments indeterminately angular, and very fharp edged.

It is intermediate between femitranfparent and ftrongly tranflucent.

Hard, nearly in the fame degree as chalcedony.

Brittle.

Not very difficultly frangible.

Not particularly heavy; fomewhat lighter than heliotrope.

Geognostic and Geographic Situations.

Its geognoftic fituation is not known, and it has been hitherto only found among the ruins of Rome†.

Use.

It was worn by the Romans as a part of ornamental drefs.

* When it fhews more luftre it is owing to handling.

† Brochant quotes from Emmerling feveral other localities; thefe, however, apply to varieties of chalcedony, not to Plafma.

TWENTY-EIGHTH SPECIES.

Chryfopras.

Krifopras.—*Werner.*

Achates—prafius, *Wall.* t. 1. p. 292.—Chryfoprafe, *Rome d. L.* t. 2. p. 167.—Krifopras, *Wern. Cronft.* p. 99. *Id. Wid.* p. 356.—Chryfoprafium, *Kirw.* vol. 1. p. 284. —Cryfopras, *Eſtner,* b. 2. f. 349. *Id. Emm.* b. 1. f. 174. —Crifoprafio, *Nap.* p. 195. *Lam.* t. 2. p. 177.—La Chryfoprafe, *Broch,* t. 1. p. 280.—Quartz—agathe prafe, *Hauy.*

External Characters.

Its characteriftic colour is apple green, which is of all degrees of intenfity; it paffes into grafs and light piftacio and olive green, and laftly into greenifh grey. The apple green fometimes inclines to verdegris green. It is fometimes alfo marked with brownifh fpots.

It is found maffive, in angular pieces, and thick plates.

Internally it is dull; fome rare varieties are glimmering.

Its

Its characteristic fracture is even; some varieties run into small and fine splintery; others, very rarely, into flat conchoidal.

Fragments indeterminately angular, more or less sharp edged.

It is intermediate between translucent and semi-transparent, but always approaches more to the first.

Hard, but in a lower degree than chalcedony.

Not particularly difficultly frangible.

Not particularly heavy.

Specific gravity.—3,250.

Chemical Characters.

Before the blow pipe it loses its colour and transparency, and is infusible without addition.

Constituent Parts.

Silica	96,16
Lime	0,83
Oxyd of nickel	1,00

And a trace of Alumina and Oxyd of Iron.

Klaproth, t. 2. p. 133.

Geognostic

Geognostic Situation.

It is found along with quartz, opal, chalcedony, aſbeſt, lithomarge, &c. in ſerpentine.

Geographic Situation.

It has been hitherto found only at Koſemutz in lower Sileſia.

Uſe.

It is principally uſed for ring ſtones, but is rather difficult to cut and poliſh. The apple green variety is the moſt highly valued, and ring ſtones of that colour are uſually valued at 12l.

Obſervations.

1. It paſſes into hornſtone and chalcedony, and into a foſſil which is intermediate between chriſopras and opal.

2. It loſes much of its colour, when long kept in a warm and dry place, or when much expoſed to the influence of the air; on this account mineral dealers are careful to preſerve their ſpecimens in moiſt places.

3. It is often confounded with green opal, from which it differs, however, in fracture, lustre, hardness and weight.

4. May not chrysopras, plasma, and heliotrope, as well stand under chalcedony, as milk quartz and prase under quartz?

5. Very elegant specimens of this beautiful fossil are to be seen in the great cathedral at Prague, where a closet is inlaid with it.

TWENTY-NINTH SPECIES.

Flinty Slate.

Kieselschiefer.—*Werner.*

This species is by Werner divided into two subspecies. 1. Common flinty slate. 2. Lydian stone.

FIRST SUBSPECIES.

Common Flinty Slate.

Gemeiner Kiefelfchiefer.—*Werner.*

Id. Wid. f. 380.—Siliceous fchiftus, *Kirw.* vol. 1, p. 306.—Kiefelfchiefer, *Eſtner*, b. 2. f. 343. *Id. Emm.* b. 1. f. 178.—Schifto filiceo, *Nap.* p. 244.—Schifte filicieux commun. *Broch.* t. 1. p. 283.

External Characters.

Its principal colour is grey, of which the following varieties occur: afh grey, which paffes into blueifh grey, from blueifh grey into pearl grey, and cherry red, which approaches to blood red.

It is pretty often flamed and fpotted, feldomer ftriped, and irregularly clouded.

It is often traverfed by quartz veins.

It occurs maffive, in whole beds, and frequently in blunt angled pieces, which have a fmooth and glimmering furface.

Internally it is faintly glimmering, and almoft dull.

Fracture in the great is generally imperfectly flaty, and in the fmall is intermediate between fplintery and uneven, and fometimes inclines to flat conchoidal.

Fragments indeterminately angular and pretty ſharp edged.

It ſometimes occurs in lamellar diſtinct concretions.

It is more or leſs tranſlucent, and paſſes into tranſlucent on the edges.

Hard.

Brittle.

Difficultly frangible.

Not particularly heavy.

Geognostic Situation.

It occurs in beds in tranſition mountains, and probably alſo in ſome floetz formations.

Geographic Situation.

It is found in Saxony, Harz, and in various parts of the great tract of tranſition rocks in the ſouth of Scotland, as at Lead Hills, Carlips, and Moorfoot Hills, near Edinburgh.

SECOND SUBSPECIES.

Lydian Stone.

Lidifcherftein.—*Werner.*

Lapis Lydius, *Wall.* t. 1. p. 353.—L. Stein, *Wid.* p. 360. Bafanite, *Kirw.* vol. 1. p. 307.—Lidifcherftein, *Eftner*, b. 2. f. 346. *Id. Emm.* b. 1. f. 181.—Schiflo filicio, *Nap.* p. 241.—Lydienne, *Lam.* t. 2. p 384.—La pierre de Lydie, *Broch.* t. 1. p. 286.

External Characters.

Its colour is greyifh black, which paffes into velvet black.

It occurs maffive, and is alfo frequently found in trapezoidal fhaped rolled pieces, with rounded angles.

It is, like the preceding fubfpecies, traverfed by quartz veins.

The external furface is fmooth and gliftening.

Internally it is glimmering.

Fracture is perfectly even, and approaches fometimes to the flat conchoidal, fometimes to the uneven.

Fragments are indeterminately angular, more or lefs fharp edged, and approach fometimes to the cubical fhape.

Opaque.

Opaque,
Hard, but not in a high degree,
Pretty eafily frangible,
Not particularly heavy.

Geognoftic Situation.

It is found in fimilar formations and repofitories with flinty flate.

Geographic Situation.

Found near Prague and Carlfbad in Bohemia; at Hainchen near Freyberg in Saxony; in the Harz, and in the Moorfoot and Pentland Hills, near Edinburgh.

Ufe.

When polifhed, it is ufed as a teft ftone, for determining the purity of gold and filver: owing, however, to its great hardnefs, it is lefs fuited for this purpofe than bafalt, and fome varieties of clay flate.

Obfervations.

Obſervations.

1. Baſalt, and certain compact varieties of clay ſlate, are what many of the French mineralogiſts conſider to be Lydian ſtone.

2. Humbold, from a ſeries of experiments which he made on this foſſil, aſſerts that it contains a portion of carbone, which is alſo countenanced from geognoſtic data.

3. It is ſaid to have been firſt found in the province of Lydia in Leſſer Aſia, whence its name.

THIRTIETH

THIRTIETH SPECIES.

Cat's-eye.

Katzenauge.—*Werner.*

Pfeudopalus opacus radios—Oculus cati, *Wall.* t. 1. p. 296. —Oeil de chat, *R. d. L.* t. 2. p. 145.—Variety of mondftein, or Adularia, *Wid.* p. 344.—Cat's-eye, *Kirw.* vol. 1. p. 301.—Katzenauge, *Emm.* b. 1. f. 188.—Occhio di gatto, *Nap.* p. 225.—Oeil de chat, *Lam.* 2. p. 152. *Id. Broch.* t. 1. p. 292.—Quartz agathe chatoyant, *Hauy.*

External Characters.

Its principal colour is grey, of which it prefents the following varieties: yellowifh, greenifh, and afh grey; from yellowifh grey it paffes into yellowifh brown, and into a kind of ifabella yellow; and further into yellowifh, reddifh, and hair brown, and into a colour intermediate between hyacinth and brick red. From greenifh grey it paffes into mountain green and olive green; and from afh grey into greyifh black.

It is found in blunt edged pieces, in rolled pieces, and alfo maffive *.

* It is ufually brought into Europe cut.

Internally

Internally it is ſhining, and intermediate between vitreous and reſinous.

Fracture ſmall and a little imperfectly conchoidal, ſometimes approaching the uneven.

Fragments indeterminately angular, and more or leſs ſharp edged.

It is commonly tranſlucent, ſometimes alſo ſemi-tranſparent, and in other varieties only tranſlucent on the edges.

It ſometimes preſents ſlender white rather opaque fibres that are parallel to each other; the particular appearance, which is termed chatoyant, is produced by the reflection of the rays of light from theſe fibres.

Hard.

Eaſily frangible.

Not particularly heavy.

Specific gravity—From 2,625 to 2,600, *Klaproth.*

Chemical Characters.

By expoſure to the heat of a porcelain furnace it loſes its hardneſs, luſtre, and tranſparency, and partly its colour, but is not melted. Before the blow pipe, according to Sauſſure, it melts with great difficulty.

Conſtituent Parts.

Silica	95,00	94,50
Alumina	1,75	2,00
Lime	1,50	1,50
Oxyd of Iron	0,25	0,25
Loſs	1,50	1,75
	100	100

Klaproth, t. 1. p. 94.

Geognostic Situation

Is unknown.

Geographic Situation.

It is brought to us from the iſland of Ceylon, and the coaſt of Malabar.

Uſe.

It is uſually cut for ring ſtones, and the red coloured variety is the moſt highly valued.

Obſervation:

Observation.

It has been by some mineralogists referred to opal, by others to felspar; it is, however, sufficiently distinguished from opal by its hardness and weight; its fracture distinguishes it from felspar.

THIRTY-FIRST SPECIES.

Prehnite.

Prehnite, *Werner.*

Wid. f. 357. *Id. Kirw.* vol. 1. p. 274. *Id. Eftner.* b. 2. f. 488. *Id. Emm.* b. 1. f. 192.—Prenite, *Nap.* p. 235. *Lam.* t. 2. p. 311.—La Prehnite, *Broch.* t. 1. p. 295. *Id. Hauy,* t. 3. p. 167.

External Characters.

Its colours are greenifh white, greenifh grey, mountain green, and apple green, which latter fometimes approaches to grafs green; alfo yellowifh grey and yellowifh green.

It is fometimes maffive, fometimes cryftallifed in oblique four-fided tables, which are pretty often truncated on the acuter angles. When thefe truncations increafe, a longifh fix-fided table is formed; when this table becomes thicker, there is formed a four-fided prifm bevilled on both extremities, the bevilling planes are fet on the fmaller lateral planes, and the edge of the bevillment is truncated.

The

The cryſtals are either ſingle, manipularly, or *wulzförmig*, aggregated *. In this latter kind of aggregation the lateral planes are ſo grown together that only the terminal planes are to be ſeen.

Sometimes the cryſtals are a little convex in the middle, owing to exfoliation. They are ſmall and middle-ſized.

Externally the cryſtals are ſmooth and ſhining, internally ſhining inclining to gliſtening, and pearly.

Fracture ſometimes foliated with an imperfect ſingle cleavage, alſo ſometimes ſmall ſcopiformly diverging radiated.

Fragments indeterminately angular, and wedge-ſhaped.

The foliated occurs in coarſe and ſmall grained diſtinct concretions; the radiated in wedge-ſhaped priſmatic diſtinct concretions.

It is tranſlucent, but ſometimes paſſes into ſemitranſparent and tranſparent.

Hard †.

Eaſily frangible.

Not particularly heavy.

Specific gravity—Prehnite of the Cape, 26,969, *Hauy*; 2,942, *Briſſon*; 2,9423, *Kirwan*.—Prehnite of France, 26,097, *Hauy*.

* I have not found a correſponding Engliſh term for the German *wulzförmig*.

† Scratches glaſs ſlightly. *Hauy*.

Chemical

Chemical Characters.

Before the blow pipe it foams up equally, if not ſtronger than zeolite, but does not, like it, gelatinate with acids.

Constituent Parts.

	Klaproth. Prehnite of the Cape.	*Haſſenfratz.* Of France.
Silica	43,83	50,0
Alumina	30,33	20,4
Lime	18,33	23,3
Oxyd of iron	5,66	4,9
Water	1,83	0,9
Magneſia		0,5
	99,98	100
	Beobacht und endeck, II. p. 217.	*J. d. P. Febr.* 1788.

Geognostic and Geographic Situations.

It occurs in Dauphiny, in veins, of the oldeſt formation, that traverſe greenſtone ſlate; in Scotland, on the contrary, it is found in rocks belonging to the neweſt floetz trap formation, as at Edinburgh, in the baſalt of the caſtle rock. It is alſo found in porphyritic greenſtone, at Arthur's Seat, and at Friſky Hall, between

between Glafgow and Dumbarton; and in floetz trap rocks in the Ifland of Mull *, and county of Ayr. It was firft found among the mountains of fouthern Africa, by Colonel Prehn; it has fince that time been obferved in the fame country by Mr Barrow; but we have as yet no account of its African geognoftic fituation.

Obfervations.

1. It was named Prehnite by Werner, in honour of a Dutch officer, Colonel Prehn, who firft brought it from the Cape of Good Hope to Europe.

2. It has been defcribed and mentioned under a variety of names, as chryfolite, emerald, prafe, chryfoprafe of the Cape, &c.

* Mineralogy of the Scottifh Ifles.

THIRTY-SECOND SPECIES.

Zeolite.

Zeolith.—*Werner.*

This ſpecies is divided by Werner into five ſub-ſpecies, *viz.* 1. Mealy zeolite, 2. Fibrous zeolite. 3. Radiated zeolite, 4. Foliated zeolite, and 5. Cubic zeolite.

They are principally diſtinguiſhed from each other by fracture, hardneſs, and luſtre.

FIRST SUBSPECIES.

Mealy Zeolite.

Mehlzeolith.—*Werner.*

Id. Wid. p. 361.—Zeolite, *Kirw.* t. 1. p. 278.—Mehl zeolith, *Eſtner*, b. 2. ſ. 481. *Id. Emm.* b. 1. ſ. 199.—Zeolite compatta terrea, *Nap.* p. 235.—Zeolithe terreuſe, or meſotype, *Hauy*.—La zeolite farineuſe, *Broch.* t. 1. p. 298.

External Characters.

Its colours are yellowiſh and reddiſh white; the latter ſometimes paſſes to pale fleſh red, and even approaches to brick red.

It occurs maſſive, coralloidal, and ſometimes it forms a cruſt over the other ſubſpecies of zeolite.

Internally it is dull.

Fracture coarſe earthy; but when it verges on the fibrous, approaches to delicately fibrous.

Fragments indeterminately angular blunt edged.

Opaque.

Very ſoft, paſſing into friable,

Eaſily frangible,

Light.

When the finger is made to paſs acroſs it, it emits a grating ſound, not unlike that of burnt brick.

Constituent Parts.

Silica	50,0
Alumina	20,0
Lime	8,0
Water	22,0
	100,0

According to *Pelletier*. *J. d. P.* t. 22, p. 420.

Geognostic Situation.

It occurs in ſimilar repoſitories with the other ſpecies.

Geographic Situation.

It is found in Iceland, Faroe Iſlands, Sweden, and in various parts of Scotland, particularly in the Iſle of Skye *, and near Tantallon Caſtle in Berwickſhire.

* Mineralogy of the Scottiſh iſles.

SECOND SUBSPECIES.

Fibrous Zeolite.

Fafriger Zeolith.—*Werner.*

Gemeiner zeolite, *Wid.* p. 363.—Zeolith, *Kirw.* p. 278. Strahliger zeolith, *Emm.* b. 1. f. 200.—Zeolith commune, *Nap.* p. 228.—Zeolithe fibreufe, *Broch.* t. 1. p. 299.—Mefotype, *Hauy,* t. 3. p. 151.

External Characters.

Its colours are fnow white, yellowifh white, greenifh white, and reddifh white; from yellowifh white it paffes into a colour intermediate between wax and ochre yellow; from greenifh white into greenifh grey, and from reddifh white into flefh red. Green is the rareft colour, and yellow occurs but feldom.

It occurs not only maffive, but alfo in angular pieces, in balls, fmall reniform, and in capillary cryftals.

Internally its luftre is glimmering, which borders on gliftening, and is pearly.

 Fracture

Fracture delicately and coarſely fibrous, ſtraight, and ſtellularly and ſcopiformly fibrous, alſo ſplintery.

Fragments wedge ſhaped.

It occurs in large and coarſe grained, ſometimes in ſmall grained diſtinct concretions.

Tranſlucent.

Semi-hard in an inferior degree.

Brittle.

Eaſily frangible.

Intermediate between not particularly heavy and light.

Conſtituent Parts.

Silica	41,0
Alumina	31,0
Lime	11,0
Water	15,0

According to *Meyer*.

Its geognoſtic and geographic ſituations are the ſame with the following ſubſpecies.

THIRD

THIRD SUBSPECIES.

Radiated *Zeolite*.

Strahliger Zeolith.—*Werner*.

Id. Wid. p. 363. *Id. Emm.* b. 1. f. 202.—Zeolite commune, *Nap.* p. 228.—Zeolite, firft variety, *Lam.* t. 2. p. 305.—Zeolithe rayonnée, *Broch.* t. 1. p. 301.—Mefotype, *Hauy*.

External Characters.

It only occurs yellowifh, greyifh, reddifh, and fnow white.

It is found maffive, globular, alfo frequently cryftallifed.

1. In very broad rectangular four-fided prifms, acuminated on both extremities by four planes, which are fet on the lateral edges; and the extremity of the acumination is often truncated. When the plane of truncation increafes very much, it forms a terminal plane, and the acuminating planes form truncations on the angles.

2. In

2. In rectangular four-sided prisms, acuminated on both extremities by four planes, which are set on the lateral planes: sometimes the prisms are so thin that they may be viewed as longish six-sided tables, bevilled on their four smaller terminal planes; sometimes two of the terminal planes became so large as nearly to form an oblique four-sided table.

The crystals are often manipularly aggregated, and frequently so grown together that the acuminations only are visible, and project like pyramids. The crystals are middle sized and small. The broader lateral planes are smooth, and longitudinally sheathed.

External lustre shining, approaching to splendent and pearly. Internally glistening and completely pearly.

Fracture narrow and broad, straight and curved, and stellularly and scopiformly diverging—radiated. The broad radiated borders on the foliated, and the narrow on the fibrous fracture.

Fragments sometimes indeterminately angular, sometimes wedge-shaped.

It occurs in large and coarse, even sometimes approaching to the small grained, longish distinct concretions.

It is translucent; the crystals are sometimes semitransparent and duplicating transparent *.

* Hauy.

Semi-hard;

Semi-hard *.
Brittle.
Eafily frangible.
Not particularly heavy, paffing into light.
Specific gravity—From 2,035 to 2,488, *Bergman.*—2,0833, *Hauy.*

Conftituent Parts.

Silica	52,0
Alumina	17,5
Lime	9,0
Water	18,5
Lofs	3,0
	100,0

According to *Vauquelin*, *J. d. M.* N. 39, p. 164.

* Scratches calc fpar. *Hauy.*

FOURTH

FOURTH SUBSPECIES.

Foliated Zeolite.

Blættriger Zeolith.—*Werner*.

Gemeiner Zeolith, *Wid.* p. 363—Zeolith. *Kirw.* vol. 1. p. 278.—Blättriger Zeolith. *Emm.* b. 1. f. 204.—Zeolite commune, *Nap.* p. 228.—Zeolithe nacrée, *Lam.* t. 2. p. 305.—Zeolithe lamelleufe, *Broch.* t. 1. p. 302.—Stilbite, *Hauy**.

External Characters.

Its colour is almoft always yellowifh and greyifh white, feldom fnow and reddifh white.

It occurs maffive, globular, in amygdaloidal-fhaped pieces, and alfo cryftallized.

1. In fhort and very oblique, four-fided prifms, in which fometimes the lateral edges and angles are more or lefs deeply truncated.
2. When the truncations on the acuter lateral edges increafe a fix-fided prifm is formed, and when thefe prifms become very fhort,

* The variety entitled Stilbite dodecaedre belongs to the radiated zeolite.

they

they appear as equilateral ſix-ſided tables.

The cryſtals are ſmall and middle-ſized, and occur in druſes, and their ſurface is ſmooth and ſplendent.

Internally its luſtre is ſhining, which approaches to ſplendent, and is completely pearly.

Fracture perfectly foliated, the folia a little curved, with a ſimple cleavage: ſometimes it is conchoidal.

Occurs in large, coarſe, and ſmall grained diſtinct concretions, ſeldom in lamellar, a little curved diſtinct concretions, nearly reſembling ſtraight lamellar heavy ſpar.

The maſſive is very ſtrongly tranſlucent, but the cryſtals are ſemitranſparent, ſometimes even tranſparent.

Semi-hard.

Eaſily frangible.

Intermediate between not particularly heavy and light.

Constituent Parts.

Silica	58,3	52,6
Alumina	17,2	17,5
Lime	6,6	9,0
Water	17,5	18,5
	Loſs	3,0
		100,05th
	According to *Meyer*.	According to *Vauquelin*.

FIFTH SUBSPECIES.

Cubic Zeolite.

Wurfel Zeolith.—*Werner.*

Zeolith cubique, *Lam.* t. 2. p. 307.—Chabafie, and analcime, *Hauy*, t. 3. p. 180. and 176.—La zeolithe cubique, *Broch.* t. 2. p. 304.

External Characters.

Its colour is greyifh white, bordering on yellowifh white; alfo reddifh brown.

Occurs maffive, but moft commonly cryftallized.

1. Perfect fmooth planed cube.
2. The cube acuminated on each angle by three planes which are fet on the lateral planes.
3. When the acuminating planes in the preceding variety increafe fo much as to caufe the original faces of the cube to difappear, a 24-fided figure, refembling that of the leuzite, is formed.

Cryftals penetrate, and fometimes are aggregated on each other, and they are fmall and middle fized.

Externally

Externally its luſtre is ſplendent and intermediate between pearly and vitreous. Internally it is ſhining.

Fracture very imperfectly foliated, cleavage three-fold, and the folia interſect each other under right angles, and parallel with the planes of the cube. Sometimes alſo paſſes into coarſe grained uneven.

Fragments indeterminately angular, approaching to cubical.

Has a tendency to coarſe and fine grained diſtinct concretions.

Alternates from tranſlucent to tranſparent.

Semi-hard, but in a higher degree than the preceding ſubſpecies*.

Not particularly heavy.

Specific gravity.—2,716, *Hauy*.

Chemical Characters.

Before the blow pipe it intumeſces like borax, and melts eaſily into a cellular glaſs, and during fuſion emits a phoſphoric light. With acid it forms a jelly†.

* Scratches glaſs ſlightly.—*Hauy*.

† It is diſtinguiſhed from leuzite, by its eaſy fuſibility.

Obſervations.

1. Hauy has formed of this ſubſpecies two diſtinct ſpecies, but without ſufficient reaſon.

2. The leuzitic cryſtallization of cubic zeolite is conſidered by Reuſs and other mineralogiſts as identical with leuzite. Independent of its different external character, however, the cubic zeolite is geognoſtically diſtinguiſhed from leuzite. Leuzite occurs in cryſtals, which are all around cryſtallized, or in grains, both of which are imbedded, and conſequently of cotemporaneous origin with the rock in which they are found. The cubic zeolite, on the contrary, is found covering the walls of air cells in amygdaloid, therefore is of poſterior origin to the rock in which it occurs.

Geognostic Situation of Zeolite.

In general it occurs in rocks belonging to the lateſt formation, particularly in thoſe of the neweſt floetz trap, as amygdaloid, baſalt, wacce, porphyry ſlate, and greenſtone. It is alſo, although rarely, found in primitive greenſtone*.

* In the royal cabinet of minerals at Berlin I ſaw ſpecimens of primitive greenſtone, from Sweden, containing zeolite.

Occurs either diſſeminated, in cotemporaneous balls, or lining or filling up air cavities or veins. At Strontian the foliated zeolite is found in mineral veins along with lead glance and ſtrontiane; the ſame variety occurs in lead veins in the Harz; and, according to Hauy, the cubic zeolite is found at Oberſtein in the interior of agate druſes.

Geographic Situation of Zeolite.

All the different ſubſpecies of zeolite are found in Scotland. The mealy zeolite, as already mentioned, occurs in the iſland of Skye, and in the rocks oppoſite the Baſs in Berwickſhire: the fibrous and radiated ſubſpecies are found in the iſlands of Cannay and Skye; the foliated in Staffa, and the cubic in Staffa, and near Talyſker in the iſland of Skye*. They are alſo met with uncommonly fine in the iſland of Iceland, the Farroe iſles, and in ſeveral places in Sweden, as at Adelfors, &c. In Germany, they are found in the Harz; Bohemia, Heſſia, Tyrol, Tranſilvania, and in the Eaſt Indies, as in the iſland of Elephanta†.

* Mineralogy of the Scottiſh iſles.

† I have ſpecimens from Elephanta.

THIRTY-

THIRTY-FIRST SPECIES.

Crofs Stone.

Kreutzftein.—*Werner.*

Hyacinth blanche cruciforme, *R. d. L.* t. 2. p. 299.—Stauıolite, *Kirw.* v. 1. p. 282. *Efstner*, b. 2. f. 499. *Id. Emm.* b. f. 209.—Ercinite, *Nap.* p. 239.—Andreolithe, *Lam.* t. 2. p. 285.—Harmotome, *Hauy*, t. 3. p. 191.—Pierre Crucifoıme, *Broch.* t. 1. p. 311.

External Characters.

Its colour is greyifh white.

It occurs cryftallized.

1. In broad rectangular four-fided prifms, acuminated by four planes which are fet on the lateral edges.
2. In twin cryftals, which are formed by two of the cryftals No. 1. interfecting each other with their broader planes in fuch a manner that a common axis and acumination is formed, and the broader lateral planes make four right angled re-entering angles.

The cryftals are almoft always fmall, and aggregated on one another; furface fmooth or drufy.

Both

Both internal and external luſtre is ſhining, which ſometimes inclines to ſplendent, ſometimes to gliſtening, and is intermediate between pearly and vitreous.

Croſs fracture uneven and ſometimes alſo ſmall conchoidal, but in other directions foliated.

Fragments indeterminately angular.

Tranſlucent, paſſing to tranſparent.

Semi-hard, ſomewhat more than zeolite*.

Eaſily frangible, Brittle

Not particularly heavy.

Specific gravity——2,355 to 2,361, *Kirwan*——2, 353 *Heyer*.—2,333, *Hauy*.

Chemical Characters.

Lelievre aſſerts that it is fuſible without addition into a white tranſparent glaſs, before the blow pipe. Other chemiſts affirm that it is completely infuſible without addition. It does not form a gelly with acids, and, according to Hauy, when powdered and thrown on charcoal emits a greeniſh yellow phoſphoric light.

* Scratches glaſs eaſily.—*Hauy*.

Constituent Parts.

Silica	44	44 to 47	49
Alumina	20	20 to 12	16
Baryt	24	25 to 20	18
Water	12	16 to 16	15
Iron		4	
	100	100 99	98
	Heyer.	*Weſtrumb.*	*Klaproth.*

Geognostic and Geographic Situations.

It has been hitherto found only in mineral veins, and in agate balls. At Andreaſberg in the Harz it occurs in veins accompanied with quartz, calc ſpar, lead glance, copper pyrites, iron pyrites, fahle ore, &c. and generally occurs in druſes, and of all the materials of the vein it is the neweſt. Strontian in Argyleſhire is the only other place where it has been obſerved in veins. At Oberſtein it occurs in ſingle cryſtals in agate balls, according to Hauy.

THIRTY-

THIRTY-SECOND SPECIES.

Azure Stone.

Lazurſtein.—*Werner*.

Zeolithes particulis &c. Lapis lazzuli, *Wall.* t. 2. p. 326. —Lapis lazzuli, *R. d. L.* t. 2. p. 49.—Lazurſtein, *Wid.* p. 371.—Lapis lazuli, *Kirw.* vol. 1. p. 283.—Lapis lazzoli, *Nap.* p. 241. — Lazulite, *Lam.* t. 2. p. 185. — La pierre d'azur, *Broch.* t. 1. p. 313.—Lazulite, *Hauy*, t. 3. p. 145.

External Characters.

Colour perfect azure blue; in ſome varieties it paſſes into Berlin blue, even ſometimes approaches to ſky blue; and other varieties occur ſmalt blue of all degrees of intenſity.

It is found maſſive, diſſeminated, and in rolled pieces.

Luſtre gliſtening and glimmering.

Fracture fine grained uneven.

Fragments indeterminately angular, not particularly ſharp-edged.

Tranſlucent on the edges.

Pretty hard*.

* Scratches glaſs.—*Hauy*.

 Britle.

Brittle.

Eafily frangible.

Not particularly heavy.

Specific gravity—2,771, *Blumenbach.*—2,767 to 2,945, *Hauy.*—2,896, *Kirwan.*

Chemical Characters.

Before the blow pipe it lofes its colour, and melts into a whitifh enamel. When previoufly calcined and powdered, it forms a gelly with acids.

Constituent Parts.

Silica	46,0
Alumina	14,50
Carbonate of Lime	28,0
Sulphat of lime	6,50
Oxyd of iron	3,0
Water	2,0
	100

Klaproth, b. 1. f. 196.

Geognostic Situation.

Its geognoftic fituation has not been fatisfactorily afcertained. It is faid to have been found near to the

the lake Baikal in Siberia, in a vein accompanied with garnets, felſpar, and pyrites. Werner ſuſpects that it occurs in rock maſſes.

The fragments we have an opportunity of examining are generally intermixed with iron pyrites, felſpar, and quartz.

Geographic Situation.

In Aſia, it has been found in Perſia, Bucharia, China, Great Tartary, and Siberia. Mr Pennant, in his Outlines of the globe informs us that it is found in conſiderable quantities in the iſland of Hainan in the Chineſe Sea, from whence it is ſent to Canton, where it is employed in china painting.

In America, it is ſaid to have been found at Atakama in Chili.

In Europe, it has been only found among the ruins of Rome.

Uſes.

On account of its beautiful blue colour, and the fine poliſh it is capable of receiving, It is worked into various articles of dreſs, as ring ſtones, ſeal ſtones, ſnuff boxes, &c.: it is alſo uſed for ornamenting altars, in moſaic and florentine work. It is highly valued by painters, on account of the fine ultramine blue colour which is prepared from it.

Obſervations.

Obſervations.

1. The European azure ſtone is either blue felſpar or copper azure.

2. It is deſcribed by Pliny in the 10th chapter of the 37th book of his Natural Hiſtory, as a variety of ſapphire.

3. The greater number of writers have followed Cronſtedt in conſidering it as a kind of zeolite. Others have referred it to the calc genus, and ſome have even placed it among the ores of iron. Werner long ſince conſidered it as a diſtinct ſpecies, and, from its external characters, gave it its preſent place in the ſyſtem.

Lazulite.

La lazulithe, *Broch* t. 1. p. 315.

Is a foſſil which has been analyzed by Klaproth, and by ſome mineralogiſts conſidered as a diſtinct ſpecies*.

* As we have no good deſcription of this foſſil, it is not in my power to give any account of it in this volume.

FOURTH

FOURTH GENUS.

CLAY GENUS.

FIRST SPECIES.

Jaſper.

Jaſpis.—*Werner*.

Werner divides this ſpecies into ſix ſubſpecies, viz. 1. Egyptian jaſper, 2. Striped jaſper, 3. Porcelain jaſper, 4. Common jaſper, 5. Agate jaſper, and 6. Opal jaſper.

FIRST

FIRST SUBSPECIES.

Egyptian Jafper.

Egyptifcher Jafpis.—*Werner*.

Silex ægyptiacus, *Wall.* t. 1. p. 276.——Egyptian pebble, *Kirw*. vol. 1. p. 312.—Egyptifcher jafpis, *Emm.* b. 1. f. 234.—Caillou d'Egypte, *Lam.* t. 2. p. 166.—Le jafpe Egyptien, *Broch.* t. 1. p. 332.

External Characters.

Its colours are chefnut brown, yellowifh brown, ifabella yellow, and yellowifh grey; alfo blood red and brownifh red, and thefe latter are marked with ochre yellow and yellowifh brown delineations.

It is characteriftic of this foffil that the interior is of a yellowifh grey colour, which often paffes into ifabella or cream yellow, but towards the exterior is yellowifh brown and chefnut brown. The brown colour makes concentric circular delineations, and between thefe it is fpotted with black, and between the fpots are fmall arborefcent delineations of the fame colour.

Occurs

Occurs in rolled pieces, which are moſtly ſpherical, and their ſurface intermediate between uneven and rough.

Externally it is gliſtening, approaching to glimmering; internally it is gliſtening.

Fracture pretty perfectly, ſomewhat flatly, conchoidal.

Fragments indeterminately angular, ſharp edged.

A little tranſlucent on the edges.

Hard,

Pretty eaſily frangible.

Not particularly heavy.

Specific gravity—From 2,600 to 2,564.

Chemical Character.

Before the blow pipe it is infuſible without addition.

Geognoſtic Situation.

It has been hitherto found only in rolled pieces. Werner ſuſpects that it occurs imbedded in a brown ochre of iron*.

* Brochant informs us that his friend Cordier, while in Egypt obſerved this, along with other flinty ſtones, conſtituting a breccia, which formed the baſis of a great part of Egypt and the neighbouring African deſerts. Does this breccia belong to the flötz trap formation?

Geographic

Geographic Situation.

It is found in Egypt.

Use.

On account of its beautiful colour delineations, and confiderable degree of hardnefs, it is ufed for fimilar ornamental and ufeful purpofes as agate.

SECOND

SECOND SUBSPECIES.

Striped Jaſper.

Band Jaſpis.—*Werner.*

Striped Jaſper, *Kirw.* vol. 1. p. 312.—Band Jaſpis, *Emm.* b. 1. ſ. 237. — Jaſpe rubane, *Lam.* p, 165. — Le Jaſpe rubane, *Broch* t. 1, p. 334.

External Characters.

Its colours are grey, green, yellow, and red. Of grey it preſents the following varieties, pearl grey, greeniſh grey and yellowiſh grey: Of yellow, cream yellow, which paſſes into ſtraw yellow : Of green, mountain green, which paſſes into leek green and greeniſh grey: Of red, cherry red, browniſh red, and fleſh red; the cherry red paſſes into plumb blue.

There are always ſeveral colours together, and theſe are arranged in ſtriped and flamed delineations.

Always maſſive.

Internally it is dull, when an admixture of foreign ingredients does not give a ſlight degree of luſtre.

Fracture pretty perfectly conchoidal, approaching ſomewhat to the fine earthy; ſometimes it ſhews a tendency to the ſlaty, and according to this the co-

lour delineations are diſtributed. Sometimes it occurs ſmall and fine ſplintery.

Fragments indeterminately angular, pretty ſharp-edged.

A little tranſlucent on the edges; ſometimes opaque.

Pretty hard, but in a low degree.

Brittle.

Not particularly difficultly frangible.

Not particularly heavy.

Geognostic Situation.

It occurs in great beds, and in ſome countries, it even forms whole hills. It belongs to the floetz formations, and probably to the newer clay ſtone formation.

Geographic Situation.

It is found in Saxony, alſo in great quantity and very beautiful in Siberia; probably alſo in the Pentland hills near Edinburgh.

Uſe.

It receives a good poliſh, and hence is uſed for ornamental purpoſes.

Obſervations.

Obſervations.

1. It derives its name from the ſtriped colour delineations with which it is marked. The common name, ribbon jaſper, is not appropriate. I have therefore employed Mr Kirwan's denomination, Striped Jaſper.

2. Werner ſuſpects that it is allied to conchoidal hornſtone. He is alſo of opinion that its colour is not original, but produced by an infiltration of oxyd of iron. — This striped jasper has also been found in transition country, in [illegible]

THIRD SUBSPECIES.

Porcelaine Jaſper.

Porzellan Jaſpis.—*Werner.*

Id. Wid. p. 314.—Porcellanite, *Kirw.* vol. 1. p. 313.—Porzellan-Jaſpis, *Eſtner.* b. 2. ſ. 613. *Ibid Emm.* b. 1. ſ. 240.—Diaſpro porcellanico, *Nap.* p. 192.—Jaſpe porcelaine, *Lam.* t. 2. p. 166. *Ibid Broch.* t. 1. p. 166.—Thermantide porcellanite, *Haüy*, t. 4. p. 510.

External Characters.

Its colours are grey, yellow, blue and red. Of grey, it preſents the following varieties, ſmoke, blueiſh, yellowiſh and pearl grey ; from pearl grey it paſſes into lilac blue and lavender blue ; alſo into brick red, which inclines to yellow ; from yellowiſh grey it paſſes into ſtraw yellow, and ochre yellow ; from ſmoke grey into greyiſh black and aſh grey.

It generally exhibits but one colour, and is ſometimes marked with dotted, flamed, and clouded delineations.

The grey varieties are generally brick red in the rifts. It often preſents brick red vegetable impreſſions ;

ſions; and this is moſt frequently the caſe with the lavender blue varieties.

Occurs moſt commonly maſſive, and in angular pieces, alſo frequently rent and burſten.

Internally its luſtre is glimmering, ſometimes gliſtening, and but ſeldom ſhining.

Fracture imperfectly large and flat conchoidal, alſo ſmall conchoidal, which paſſes into uneven and earthy. Some rare varieties ſhew a tendency to the ſlaty fracture.

Fragments indeterminately angular and ſharp edged.

Opaque.

Pretty hard.

Uncommonly brittle.

Not particularly heavy.

Chemical Character.

Before the blow pipe it melts without addition into a black ſcoria.

Constituent Parts.

Silica	60,75
Alumina	27,25
Magneſia	3,00
Oxyd of iron	2,50
Potaſh	3,66

According to *Roſe.*

Geognostic Situation.

It occurs in whole beds in pſeudo volcanic hills. Werner is of opinion that it is ſlaty clay converted into a kind of porcelain by the action of pſeudo volcanic fires.

Geographic Situation.

It is found plentifully in Bohemia, in the neighbourhood of pſeudo volcanoes.

FOURTH SUBSPECIES.

Common Jaſper.

Gemeiner Jaſpis.—*Werner.*

This ſubſpecies Werner divides into two kinds. *a.* Conchoidal common jaſper. *b.* Earthy common jaſper.

a. Conchoidal common Jaſper.

External Characters.

It is moſt commonly brown and red, alſo yellow. Of brown it preſents the following varieties; yellowiſh and liver brown, which latter ſometimes paſſes into blackiſh brown; the yellow is always ochre yellow; the red is blood red, which rarely paſſes into ſcarlet red, and ſometimes into cochineal red, but oftener into browniſh red; black is browniſh black.

Occurs generally with one colour; when ſeveral occur together, they are diſtributed into clouded, ſpotted, and ſtriped delineations.

Occurs

Occurs moſt commonly maſſive, alſo finely diſſeminated in chalcedony, and moſs-like in agate. The ſtriped variety is ſometimes imbedded in quartz.

Internally its luſtre is ſhining, which approaches gliſtening, and is intermediate between vitreous and reſinous.

Fracture more or leſs perfectly conchoidal, paſſing into even and fine earthy.

Fragments indeterminately angular, more or leſs ſharp edged.

Uſually opaque, ſeldom tranſlucent on the edges, and that only when it approaches to jaſper agate.

Pretty hard, but in a higher degree than the following kind.

Brittle.

Eaſily frangible.

Not particularly heavy.

b. Earthy common Jaſper.

Its colours are blood red and browniſh red; the latter paſſes into brown.

Occurs maſſive and in rolled pieces.

Fracture earthy.

Fragments indeterminately angular, not particularly ſharp edged.

Opaque.

Pretty hard, but in an inferior degree,

Pretty eaſily frangible.

Not particularly heavy.

Geognostic

Geognostic Situation.

It is generally found in veins that occur in primitive rocks, and is a conftituent part of thofe agates that are found in amygdaloid. It is frequently traverfed by quartz veins, and is fometimes mixed with pyrites, lithomarge, femiopal, brown fpar and native and vitreous filver ore. It has been fuppofed to form the bafis of certain kinds of porphyry ; but this is not the cafe ; the bafis of thefe porphyries, as Werner firft obferved, is either hornftone, indurated clay, or compact felfpar.

Geographic Situation.

It is found in Saxony, Bohemia, France, Spain, Italy, Hungary, Ruffia, Sweden, Shetland iflands*, and the tranfition rocks near Edinburgh.

* Mineralogy of the Scottifh Ifles.

FIFTH SUBSPECIES.

Jaſper Agate.

Agat-Jaſpis.—*Werner.*

External Characters.

Colour is yellowiſh white and reddiſh white; the yellowiſh white paſſes into cream and ſtraw yellow, and approaches to ochre yellow; the reddiſh white paſſes into fleſh red. The colours are diſtributed in ring-ſhaped delineations, alſo in fortification-wiſe bent ſtripes.

Occurs maſſive.

Has no luſtre.

Fracture ſmall and flat conchoidal, approaching to even.

Fragments indeterminately angular, not particularly ſharp edged.

Generally opaque, ſometimes tranſlucent on the edges.

Pretty hard.

Often adheres to the tongue.

Not particularly heavy, approaching to light.

Geognoſtic

Geognostic Situation.

Occurs in agate balls, which are found in amygdaloid.

SIXTH SUBSPECIES.

Opal Jaſper.

Opal Jaſpis,—*Werner.*

External Characters.

Its colours are ſcarlet red, brick red, blood red, browniſh red, and blackiſh brown, which latter approaches to liver brown, and rarely to ochre yellow.

Colour ſometimes uniform, ſometimes diſtributed in ſpotted, veined, and clouded delineations.

Occurs maſſive.

Internally its luſtre is ſhining, approaching to ſplendent, and is intermediate between vitreous and reſinous.

Fracture completely a little flat, conchoidal.

Fragments indeterminately angular, and very ſharp edged.

Opaque, and ſometimes tranſlucent on the edges.

Intermediate between pretty hard and ſemi-hard.

Brittle.

Eaſily frangible.

Not particularly heavy, approaching to light.

Geognostic and Geographic Situations.

It is found in neſts (nidular) in porphyry, near Tokay in Hungary, near Conſtantinople, and in the Kolyvanian mountains in Siberia.

Obſervations.

1. It is the link which connects jaſper with opal, as is ſhewn, not only by its oryctognoſtic, but alſo by its geognoſtic characters.

2. It is diſtinguiſhed from the five preceding ſubſpecies by its greater livelineſs of colour, ſtronger luſtre, conſtant conchoidal fracture, eaſier frangibility, and inferior hardneſs.

Obſervation on the ſpecies Jaſper.

The foſſils of this ſpecies have generally deep colours, are opaque, or a little tranſlucent on the edges; their

their fracture is generally conchoidal, and they are pretty hard, but rather in a low degree.

On the one ſide they are allied to indurated clay and lithomarge, on the other to hornſtone, opal, chalcedony, and flint.

SECOND SPECIES.

Opal.

Opal.—*Werner.*

Werner divides this ſpecies into four ſub-ſpecies, *viz.* 1. Precious opal, 2. Common opal, 3. Semi-opal, and 4. Wood opal.

FIRST SUBSPECIES.

Precious Opal.

Edler Opal.—*Werner.*

Id. Wid. p. 325.—Opal, *Kirw.* t. 1. p. 289.—Edler opal, *Emm.* b. 1. f. 341.—Opalo, *Nap.* p. 197.—Opale, *Lam.* t. 2. p. 154.—L'Opale noble, *Broch.* t. 1. p. 341.—Quartz-refinite opalin, *Hauy,* t. 2. p. 434.

External Characters.

Its colours are milk and yellowiſh white, but when held between the eye and the light they paſs into pale roſe red, and wine yellow.

It exhibits a moſt beautiful, and highly characteriſtic play of colours. The colours which it diſplays are verdegris green, emerald green, apple green, and ſiſkin green; alſo ſeveral varieties of blue, yellow, and red. Generally ſeveral of theſe colours occur together; ſometimes, however, we meet with pieces which poſſeſs only one colour, and of theſe varieties, the green is the moſt beautiful and moſt highly valued.

Occurs maſſive, diſſeminated, in plates, and in ſtrings or ſmall veins.

Internally

Internally its luftre is commonly fplendent, feldom paffing into fhining, and is vitreous.

Fracture pretty perfectly conchoidal.

Fragments indeterminately angular, fharp edged.

It is generally tranflucent, and fometimes approaches to faintly tranflucent, fometimes to femitranfparent, but feldom verges on tranfparent. The different degrees of tranfparency are accompanied by particular colours; thus the tranflucent paffing into faintly tranflucent has generally a beautiful red and green play of colours, and is the moft highly prized variety of opal: the varieties that are intermediate between tranflucent and femi-tranfparent are principally grey; and the femi-tranfparent paffing into tranfparent exhibits a beautiful violet blue play of colours.

Semi-hard.

Brittle.

Uncommonly eafily frangible,

Not particularly heavy, bordering on light.

Specific gravity—2,114, *Blumenbach.*

Chemical Characters.

Before the blow pipe it becomes opaque, and milkwhite, but is infufible.

Conſtituent Parts.

Silica	90	95
Water	10	
Alumina		5
	100	100
	Opal of Cſcherwenitza, according to *Klaproth*.	According to *Gerhard*.

Geognostic Situation.

It occurs diſſeminated in clay porphyry, and according to Mr Da Camara, imbedded in reniform pieces in pearlſtone porphyry.

Geographic Situation.

It is found at Cſcherwenitza near Kaſchau in Upper Hungary, and formerly in the neighbourhood of Freyberg in Saxony.

Uſe.

Although much prized on account of its beautiful play of colours, it is but ill ſuited for the purpoſes of jewellery, on account of its ſoftneſs, great frangibility,

ty, and its fometimes fplitting on a change of temperature. Jewellers generally fet it with a foil, but many are of opinion that its beauty is greateft without any foreign aid. When a foil is ufed, it is either red, blue, or yellow, which latter is of gold; but it is faid that a black foil has the moft powerful effect in heightening its play of colours. It is principally ufed for ring ftones and necklaces.

Obfervations.

1. The name opal is ufed by Pliny, but its derivation is unknown.

2. The finer varieties are named oriental opal; Tavernier, however, informs us that no precious opal is found in the Eaft, and that thofe which are fold as oriental are brought from Hungary.

3. Some varieties which have by weathering loft a portion of their water of cryftallization become opaque and dull, and acquire the property of adhering to the tongue, and of regaining nearly their original tranfparency on immerfion in water. Thefe are named Hydrophane, or, more properly, changeable opal. Great prices have been given for varieties of this kind.

4. In the imperial cabinet at Vienna there are two pieces of opal from the mines in Hungary, which deferve to be mentioned here. The one is about five inches long and two and a half in diameter, and ex-

hibits a very rich and ſplendent play of colours; the other, which is the ſize and ſhape of a hen's egg, is alſo extremely beautiful.

SECOND SUBSPECIES.

Common Opal.

Gemeiner Opal.—*Werner.*

Id. Wid. p. 325.—Semi opal, *Kirw.* vol. 1. p. 290.—Gemeiner opal, *Emm.* b. 1. f. 251.—Opalo, *Nap.* p. 197.—Giraſol and Hydrophane, *Lam.* p. 156.—L'opal commune, *Broch*, t. 1. p. 344.—Quartz-reſinite hydrophane et quartz-reſinite giraſol, *Hauy*. t. 2. p. 433. & 434.

External Characters.

Its principal colour is white, of which it exhibits the following varieties: greyiſh white, greeniſh white, yellowiſh white, and milk white. From greeniſh white it paſſes into apple green; from yellowiſh white into honey and wax yellow; and it very ſeldom occurs of a colour intermediate between fleſh and tile red.

When

When the white varieties are held between the eye and the light they appear wine yellow.

It occurs maſſive, diſſeminated, and in ſharp angular pieces.

Internally its luſtre is generally ſplendent, ſometimes paſſing into ſhining; and is vitreous, a little inclining to reſinous.

Fracture perfectly conchoidal.

Fragments indeterminately angular and ſharp edged.

Semi-tranſparent, approaching to tranſlucent and tranſparent.

Semi-hard.

Brittle.

Very eaſily frangible.

Not particularly heavy, approaching to light.

Specific gravity—From 1,958 to 2,015, *Klaproth.*—2,144, *Kirwan.*

Chemical Characters.

Before the blow pipe it is infuſible without addition.

Constituent Parts.

	Opal of Kofemutz.	Of Telkobanya.
Silica	98,75	93,50
Alumina	0,1	
Oxyd of Iron	0,1	1,0
Water		5,0
	98,95	99,50

According to *Klaproth*, t. 2. p. 164. & 169.

Geognostic Situation.

It occurs fometimes in veins, fometimes diffeminated, and principally in porphyry; but alfo in granite, gneifs, ferpentine, and amygdaloid. In Iceland it alternates with chalcedony, with which it has been often confounded; and the green variety is found accompanying chrifopras, which lies in ferpentine, at Kofemutz in Silefia.

Geographic Situation.

It is found in Iceland, the Faroe Iflands, North of Ireland, in the electorate of Saxony, as at Freyberg, Hubertfberg, Eibenftock, Johanngeorgenftadt, and Schneeberg; in Bohemia, as at Bleiftadt, Fribus, Heinrichfgrün;

Heinrichſgrün; Brittany in France; Sileſia, Poland, at Florence in Italy, and Telkobanya in Hungary.

Uſe.

It is ſometimes cut for ornamental purpoſes.

Obſervations.

1. Some varieties contain drops of water, and others are in the ſtate of hyrophane, or changeable opal. If the changeable opal is immerſed in melted wax, it abſorbs a portion of it, and becomes tranſparent; but, on cooling, becomes again opaque. Opal thus impregnated with wax was named Pyrophane by Born.

2. Mullers glaſs, or Hyalite of Mr. Kirwan, which occurs in amygdaloid, probably belongs to this ſubſpecies.

3. The giraſol of Wallerius and Born appears to be milk-white tranſlucent opal.

4. It has been conſidered by the French mineralogiſts as a variety of pitchſtone, from which, however, it is moſt diſtinctly different. The colours of common opal are light, but thoſe of pitchſtone are deep; it is ſemi-hard, but pitchſtone is hard; it has a ſpecific gravity from 1,958 to 2,015, whereas pitchſtone is 2,341; and it is more eaſily frangible and has more tranſparency than pitchſtone.

THIRD SUBSPECIES.

Semi-opal.

Halb-opal.—*Werner.*

Id. Wid. f. 325.—Semi-opal, and feveral of the pitchftones of *Kirw.* vol. 1, p. 290, 292.—Halb-opal, *Emm.* b. 1. f. 256. *Id. Eftner*, b. 2. f. 429.—Semi-opalo, *Nap.* p. 201.—Piffite, *Lam.* t. 2. p. 160.—La demi opal, *Broch.* t. 1. p. 347.—Quartz-refinite commune, and Q. R. Menilite, *Hauy.* t. 2. p. 433. & 335.

External Characters.

Its moft common colours are white and grey. Of white it prefents the following varieties: yellowifh white, greenifh white, and milk white; from yellowifh white it paffes into yellowifh grey, greenifh grey, and afh grey, and this latter into greyifh black. From greenifh grey it paffes into leek green, apple green, and laftly into olive green; from yellowifh grey it paffes into honey yellow, wax yellow, and yellowifh brown; and further into chefnut and hair brown.

Sometimes feveral colours occur together, and thefe are arranged in fpotted and clouded delinea-

tions;

tions; but it is moſt commonly uniform or of one colour.

It occurs not only maſſive and diſſeminated, but alſo tuberoſe, reniform, ſmall botroidal, which approaches to the ſtalactitic, and in various extraneous external ſhapes *.

Externally it is gliſtening, internally generally gliſtening, ſometimes approaching to ſhining, and paſſing into glimmering.

Fracture imperfectly large and flat conchoidal, which verges on even.

Fragments indeterminately angular ſharp edged.

It is more or leſs tranſlucent, and ſometimes paſſes to tranſlucent on the edges.

Semi-hard, approaching to hard.

Completely brittle.

Eaſily frangible.

Not particularly heavy approaching to light.

Specific gravity.—Browniſh red from Telkobanya 2,540, according to *Klaproth.*

Chemical Characters.

Infuſible before the blow pipe without addition; but with borax it melts, and without intumeſcence.

* Mr. Eſmark affirms that he found ſuppoſititious cryſtals of ſemi-opal at Atzutza in Tranſylvania. *Bergm. Journal.*

Constituent

Constituent Parts.

	Semi-opal of Telkobanya.	Menilite, or ſemi-opal of Menil Montant.
Silica	43,50	85,50
Alumina		1,00
Oxyd of iron	47,00	0,50
Lime		0,50
Water	7,50	
Water and carbonaceous matter		11,00
	98,0	98,50

According to *Klaproth.*

Geognostic Situation.

It occurs in angular pieces and veins in porphyry and amygdaloid; alſo in metalliferous (moſt uſually ſilver) veins that traverſe granite and gneiſs.

Geographic Situation.

It is found in Iceland, Faroe Iſlands, Scotland, in the Iſle of Rume, where it occurs in amygdaloid, Electorate of Saxony, Bohemia, Frankfort on the Mayn, Sileſia, Lower Auſtria, Poland, Hungary, Tranſylvania, Iſle of Elba, and Siberia.

Obſervations.

Obſervations.

1. It is diſtinguiſhed from common opal by the muddineſs of its colours, its particular external ſhapes, leſſer tranſparency, leſs perfect conchoidal fracture, and greater hardneſs and weight.

2. It borders on opal jaſper, chalcedony, and conchoidal hornſtone.

3. I obſerved in the poſſeſſion of Sir Joſeph Banks a tooth penetrated with opal. Eſtner alſo mentions bones petrified by ſemi-opal; and in Hoff's Mineralogical Magazine we have the following intereſting notice:—“Hier ungefähr eine bis zwei ſtunden und noch etwas weiter nördlich von dem orte, wo ſich die elephanten knochen im *aufgeſchwemmten Lande* finden, bei den Dörfern Eckardſleben Illeben, Niedertophſtädt, Fromſtadt, liegt meiſt deütlich über dem jüngere Gyps, eine oft 10 bis 12 lachter mächtige flötz ſchicht von einem merkwurdigen kalkſtein mit kleinen quartz druſen, in welchem ſich eine menge knochen, groſtentheils wohl Fiſch knochen, aber auch Saugethier, und vielleicht Land-thier-knochen feſt eingewachſen befinden, welche zuweilen in opal verwandelt ſind.” *Hoff's Magazine, Erst. Band.* ſ. 457.

4. It has been arranged with pitchſtone by Dolomieu, Fichtel, and other mineralogiſts.

5. The menilite, or variety of ſemi-opal from Menil Montant, is probably a diſtinct ſpecies, but nearly allied to opal.

FOURTH SUBSPECIES.

Wood Opal.

Holz Opal.—*Werner.*

Id Wid. p 325.—Ligniform opal, *Kirw.* vol. 1. p. 295. Holz-opal, *Emm.* b. 1. ſ. 260.—Semi-opalo, *Nap.* p. 201.—Xilopale, *Lam.* t. 2. p. 162.—Opal ligniforme, *Broch.* t. 1. p. 350—Varieté du quartz-agathe xiloide, *Hauy.*

External Characters.

It occurs moſt commonly greyiſh and yellowiſh white; ſometimes alſo ochre yellow, and yellowiſh brown. From greyiſh white it paſſes into aſh grey and greyiſh black.

It is ſometimes uniform, ſometimes marked with ring-ſhaped and ſtriped delineations of different colours, which are conformable with the original texture of the wood.

It occurs in pieces which have the ſhape of branches, ſtems, &c.

Internally its luſtre is gliſtening.

Fracture more or leſs perfectly conchoidal, and ſhews its former ligneous texture.

Fragments indeterminately angular ſharp edged.

It

It is tranflucent.
Between femi-hard and hard.
Eafily frangible.
Not particularly heavy, bordering on light.
Specific gravity—2,600.

Geognostic and Geographic Situations.

Its geognoftic fituation is not known. It is found at Ponick near Schemnitz, and at Telkobanya in Hungary.

Obfervation.

It is wood penetrated with opal, and, according to Werner, is intermediate between common and femi-opal.

THIRD SPECIES.

Pitchſtone.

Pechſtein.—*Werner.*

Id. Wid. p. 332.—Pitchſtone, *Kirw.* vol. 1. p. 292.—Pechſtein *Eſtner*, b. 2. ſ. 435. *Id. Emm.* b. 1. ſ. 262. Pietra picea, *Nap.* p. 203.—Piſſite var. h. *Lam.* t. 2. p. 162.—La Pierre de Poix, *Broch.* t. 1. p. 353.—Petroſilex reſiniforme, *Hauy*, t. 4. p. 386.

External Characters.

Its colours are black, green, brown, red, and ſeldom grey. Of black it preſents the following varieties: greeniſh, greyiſh, and browniſh black. From greeniſh black it paſſes through blackiſh green into mountain green, aſparagus green, leek green, olive green, and oil green. From olive green it paſſes into liver brown, yellowiſh and reddiſh brown, and further into light blood and brick red. The only varieties of grey are ſmoke and dark aſh grey, and ſometimes a kind of grey which paſſes into brown. It has ſometimes a blueiſh colour.

Its

Its colours are not lively, but always ſomewhat deep and muddy, or rather mixed with grey and brown.

It is generally uniform, ſeldom ſeveral colours occur together.

It occurs almoſt always maſſive in great beds and rock maſſes

Internally its luſtre is ſhining, ſometimes ſplendent, ſometimes gliſtening, and intermediate between reſinous and vitreous, yet more inclining to the firſt.

Fracture commonly imperfectly flat and large conchoidal, ſometimes ſmall conchoidal, and even paſſes into coarſe ſplintery and coarſe grained uneven.

Fragments indeterminately angular, more or leſs ſharp edged.

It occurs ſometimes in coarſe, ſeldom in large and flat grained diſtinct concretions, and the ſurface of the concretions is ſomewhat bent; alſo in priſmatic, generally wedge ſhaped diſtinct concretions. It is ſtill ſeldomer found in thick and ſtraight lamellar diſtinct concretions*. The ſurface of the concretions ſmooth.

It is commonly tranſlucent in a ſmall degree; the black variety is only tranſlucent on the edges.

It is intermediate between hard and ſemi-hard.

Brittle.

Pretty eaſily frangible.

* Lamellar diſtinct concretions have been hitherto obſerved only in the pitchſtone of the iſland of Arran.

Not

Not particularly heavy.

Specific gravity—Saxon pitchſtone, according to *Blumenbach*, 2,314.

Chemical Characters.

Before the blow pipe it is fuſible without addition. The black variety, at 21° of Wedgwood's pyrometer, intumſced a little, its colour was ſlightly altered, the ſurface glazed, and internally porous; at 31°, intumeſced conſiderably and ſoftened; at 65°, the intumeſcence was more conſiderable; at 100°, it was ſtill veſicular but more compact. The blackiſh green variety of Arran becomes black, is much rent, and internally porous at 23°; at 55° formed a porous enamel; at 70° it became perfectly white, and ſtill porous *.

* Mineralogy of the Scottiſh iſles vol. 1.

Constituent

Constituent Parts.

Pitchſtone of Meiſſen.

Silica	73,0	64,58
Alumina	14,50	15,41
Lime	1,0	
Oxyd of iron	1,0	5,0
Oxyd of manganeſe	0,10	
Natron	1,75	
Water	8,50	
Loſs		15,0
	99,85	99,99
	Klaproth. Beiträge, b. 3. ſ. 261.	*Wiegleb.*

Geognostic Situation.

It occurs in beds in the newer porphyry formation, and in beds and veins that belong to the neweſt flötz trap formation *.

Geographic Situation.

That belonging to the newer porphyry formation is found in great quantity in the Electorate of Saxony,

* Mineralogy of the Scottiſh iſles.

particularly

particularly in the neighbourhood of Meissen; also in Hungary, as at Tokay and Schemnitz; in the islands of the Archipelago, where it was first observed by Mr Hawkins; and at Glamoscard in the Island of Skye *.

The varieties belonging to the newest floetz trap formation are found in great abundance in the Island of Arran, also in the Islands of Mull and Canna †, and near Eskdale Muir, in the mountainous part of Dumfriesshire ‡.

Probably the pitchstone of Zwickau in Upper Saxony belongs to the floetz trap formation.

Observations.

1. It was first discovered about fifty years ago in the neighbourhood of Meissen in the Electorate of Saxony.

2. It is named Pitchstone from the striking resemblance which several of its varieties bear to pitch.

3. Many of the French mineralogists have arranged it with opal, and Abbé Hauy, with equal impropriety, considers it but as a variety of petrosilex.

* Mineralogy of the Scottish isles.

† *Id.*

‡ Geognostical Sketch of Dumfriesshire.

FOURTH

FOURTH SPECIES.

Obſidian.

Obſidian.—*Werner*.

Wid. p. 348. *Kirw.* v. 1. p. 265.—Obſidiana, *Nap.* p.
Its principal fracture is ſhining, paſſing into ſplen-
205.—Lava vitreuſe, Obſidienne, *Hauy*, t. 4. p. 494.—
L'Obſidienne, *Broch.* t. 1. p. 288.—Iceland agate of
many mineralogiſts.

External Characters.

Its principal colour is velvet black; it occurs alſo greyiſh black, browniſh black, and greeniſh black; alſo dark aſh grey and ſmoke grey. Some varieties paſs into light hair brown, and clove brown *. Other varieties, particularly the aſh grey, are ſpotted and ſtriped. The black variety when held between the

* The hair and clove brown varieties are found imbedded in roundiſh pieces in pearlſtone, at the mouth of the river Mareſchanka, on the ſea of Ochotſk. Karſten conſiders them as ſpecifically diſtinct from Obſidian, and places them in his ſyſtem under the name Marekan.

eye and the light appears always greenifh on the edges.

It always occurs in angular more or lefs blunt-edged roundifh pieces, which have a rough furface. In pearlftone it occurs in roundifh grains.

Internally it is ufually fplendent, fometimes pafsing to fhining, and is vitreous.

Fracture more or lefs perfectly large conchoidal.

Fragments indeterminately angular fharp edged *.

The dark varieties are tranflucent only on the edges; but the lighter are tranflucent, and fome rare varieties (particularly the clove brown variety) are almoft femi-tranfparent, bordering on tranfparent.

Hard.

Eafily frangible.

Not particularly heavy.

Specific gravity—2,348.

Chemical Character.

According to Lampadius, when expofed to a ftrong heat in an air furnace, it lofes its colour, and is changed into a porous flag. By expofure to a white heat for two hours the cellular mafs is not melted into glafs.

* The Hungarian obfidian appears to occur in large roundifh diftinct concretions.

Constituent

Constituent Parts.

Silica	69,0	74,0
Alumina	22,0	2,0
Oxyd of iron	9,0	14,0
	100	90,0
	Bergman.	*Abilgoard.*

Geognoſtic Situation.

It is found nidular in pearlſtone in the newer porphyry formation in Hungary, and it is probable that it occurs in a ſimilar repoſitory in other parts of the world. It has ſometimes grains and cryſtals of felſpar and quartz imbedded, hence it is porphyritic.

Geographic Situation.

It is found in Iceland; in Hungary, at Tokay; in Siberia, at Ochotz, and on the banks of the river Mareſkanka; in the Iſlands of the Archipelago, particularly in the Iſland of Melos, where it was firſt diſcovered by Mr Hawkins; alſo in immenſe beds in the Lipari Iſlands; in Peru, Iſland of Madagaſcar, and ſeveral of the South Sea iſlands.

Use.

When cut and polifhed it is fometimes ufed for ornamental purpofes, and telefcopic mirrors have been made of it.

Obfervations.

1. It has been much difputed whether or not it is a product of fire. The difcovery of Efmark the Norwegian, who found it alternating with porphyry, demonftrates that in fome inftances it is of aquatic formation; it is even highly probable that the great rocks of obfidian and pumice which are found in the Lipari Iflands have had a fimilar origin.

2. It fometimes paffes into pumice.

FIFTH

FIFTH SPECIES.

Pearlſtone.

Perlſtein —*Werner*.

External Characters.

It is generally grey, ſometimes alſo black and red. The varieties of grey are ſmoke, bluiſh, aſh, yellowiſh and pearl grey; from dark aſh grey it paſſes into greyiſh black: from pearl grey into fleſh and brick red, and reddiſh brown.

It occurs veſicular, and the veſicles are round and longiſh.

Its luſtre is ſhining and pearly.

Its fracture, on account of the thinneſs of the diſtinct concretions, is hardly obſervable, but appears to be ſmall and imperfectly conchoidal.

Fragments are in the large indeterminately angular and blunt edged.

It occurs in large, coarſe, and angularly grained diſtinct concretions, that include ſmall and round grained concretions, which are again compoſed of very thin concentric lamellar concretions. The ſurface of the concretions, particularly in the ſmall, is ſmooth,

ſmooth, ſhining, and pearly, and has a ſtriking reſemblance to that of pearl.

It is tranſlucent on the edges.

Not very brittle.

Uncommonly eaſily frangible.

Soft, paſſing into very ſoft.

Not particularly heavy, approaching to light.

Constituent Parts.

Pearlſtone of Hungary.

Silica	75,25
Alumina	12,0
Oxyd of iron	1,60
Potaſh	4,50
Lime	4,50
Water	4,50
	98,35

According to *Klaproth.*

Geognostic Situation.

It is found in beds in porphyry, and often contains balls of obſidian.

Geographic

Geographic Situation.

It is found in the neighbourhood of Tokay in Hungary, near Ochotſk in Kamſchatſka, and near Sandy Brae in the north of Ireland. Some of its tranſitions to other foſſils occur in the intereſting Iſland of Egg, one of the Hebrides, and near Sandy Brae in Ireland. Does the pearlſtone of Sandy Brae belong to the floetz trap formation?

Obſervation.

The veſicular variety, particularly the longiſh, often bears a ſtriking reſemblance to pumice; indeed it appears to paſs into it.

SIXTH SPECIES.

Pumice.

Bimftein.—*Werner.*

External Characters.

Its colour is light yellowifh grey, and fmoke grey; fometimes verging on dark greyifh white, and light afh grey.

It is fmall and lengthened veficular.

The luftre of its principal fracture is gliftening, paffing to fhining, and is pearly; the crofs fracture is fhining and vitreous.

Its principal fracture is parallely curved fibrous; the crofs fracture uneven and imperfectly conchoidal.

Fragments indeterminately angular, blunt edged and fplintery.

Generally tranflucent on the edges.

Soft and very foft, fometimes approaching to femihard.

Completely brittle.

Pretty eafily frangible.

Is fwimming.

Chemical

Chemical Characters.

It melts before the blow pipe into a whitifh coloured glafs.

Constituent Parts.

Silica	90,0	77,50
Alumina		17,50
Magnefia	10,0	
Oxyd of Iron		1,75
	100,0	96,75
	Bergmann.	*Klaproth.*

Dr. Kennedy, befides the ingredients mentioned by Klaproth and Bergman, found a portion of potafh.

Geognostic Situation.

According to Efmark it is found in Hungary along with pearlftone, which alternates with porphyry. In the Lipari Iflands it is accompanied with obfidian, into which it paffes; and on the banks of the Rhine, between Andernach and Coblentz, it is found in great quantity, accompanied by rocks, that probably belong to the floetz trap formation.

Although it has been ufually claffed among the volcanic products, on account of its fuppofed igneous origin, we muft confefs that in Hungary at leaft it is demonftrably of aquatic formation ; and we may on pretty fure grounds confider that of Lipari and Andernach as a portion of one of thofe great and univerfal formations which have been depofited from a ftate of folution in water. In the Geognofie will be given a full ftatement of the interefting facts which render this opinion probable.

Geographic Situation.

It is found in the Lipari Iflands, Hungary, banks of the Rhine between Andernach and Coblentz, Iceland? and it has been obferved particularly beautiful in the Ifland of Santorine in the Hellefpontic Archipelago.

Ufes.

It is ufed for polifhing ftones, metals, glafs and ivory; alfo for preparing parchment.

SEVENTH SPECIES.

Felſpar*.

Feldſpath.—*Werner*.

This ſpecies is divided by Werner into four ſub-ſpecies, 1. Compact felſpar, 2. Common felſpar, 3, Adularia, 4. Labradore ſtone.

* More properly Feldſpar,

FIRST SUBSPECIES.

Compact Felspar.

Dichter Feldspath.—*Werner*.

Id. Wid. p. 345.—Continuous felspar, *Kirw.* vol. 1. p. 323.—Felsite, *Id.* p. 326.—Dichter feldstein, *Estner*, b. 2. s. 511. *Id. Emm.* b. 1. s. 271.—Felspato compatto, *Nap.* p. 218.—Feldspath compacte bleu, *Hauy*, t. 2. p. 615.—Le feldspath compacte, *Broch.* t. 1. p. 367.

External Characters.

Its colours are grey, white, blue, green, and red. The varieties of white are greenish and greyish white: Of grey, greenish, smoke and ash grey; from greenish grey it passes into apple green, pistacio green, even into mountain green; further into sky blue and smalt blue; it occurs also flesh red and blood red.

Occurs massive, disseminated, in rolled pieces, and in crystals, which are imbedded in antique green porphyry.

Internally its lustre is sometimes glistening, some times glimmering.

Fracture

Fracture at firſt ſight appears to be only ſplintery, but when carefully examined we find it alſo to be very fine grained, or imperfectly and very ſmall foliated.

Fragments indeterminately angular, and not particularly ſharp edged.

It ſometimes preſents fine grained diſtinct concretions.

Tranſlucent, but ſometimes only on the edges.

Pretty hard, but in a low degree.

Eaſily frangible.

Not particularly heavy.

Chemical Character.

It is fuſible without addition before the blow pipe.

Geognostic Situation.

It is one of the conſtituent parts of primitive, tranſition, and floetz greenſtone, alſo of greenſtone ſlate, and is imbedded in cryſtals in antique porphyry.

Geographic Situation.

It is found in Saxony, the Tyrol, Carinthia; in Scotland, at the Pentland hills, and Saliſbury craigs

near

near Edinburgh; Coriarich in Invernefsfhire, and many other places.

Obfervations.

On account of its fplintery fracture, and flight degree of luftre, it ufed to be confidered as a variety of hornftone; even the late intelligent Mr Dolomieu continued to name it petrofilex. Werner confiders it as a fubfpecies of felfpar, becaufe 1. It occurs moft generally along with quartz and mica, thus affuming as it were the place of common felfpar. 2. It has combined with the fplintery a foliated fracture. 3. It paffes into common felfpar. 4. It occurs cryftallized in antique green porphyry. 5. It melts without addition before the blow pipe.

SECOND SUBSPECIES.

Common Felfpar.

Gemeiner Feldfpath.—*Werner.*

Werner divides it into two kinds: *a.* Frefh felfpar, *b.* Difintegrated felfpar.

FIRST

FIRST KIND.

Frefh felfpar.

Frifcher feldfpath——*Werner.*

Spathum fcintillans, *Wall.* t. 1. p. 214.—Feldfpath, *Wid.* p. 335. *Ibid. R. d. L.* t. 2. p. 445.—Common felfpar, *Kirw.* vol. 1. p. 316—Blättrig Feldftein, *Eftner*, b. 1. f. 513.—Gemeiner feldfpath, *Emm.* b. 1. f. 266.—Feldifpato commune, *Nap.* p. 213.—Feldfpath, *Lam.* t. 2. p. 187. *Ibid. Hauy*, t. 2. p. 590.—Le Feldfpath commun. *Broch.* t. 1. p. 362.

External Characters.

Its colours are white, red, grey, and green. Of white it prefents the following varieties; greyifh, milk, yellowifh, greenifh, and reddifh white: the greyifh white rarely paffes into fmoke grey and blueifh grey. Of red the following varieties occur, flefh, blood, and fometimes verges on brick red. From greenifh white it paffes into afparagus green, leek green, mountain green, even into verdegris green, but this latter is a rare variety.

The

The greenifh white variety borders on adularia, and the edges have a reddifh fhade.

It occurs moft commonly maffive, diffeminated, in angular pieces, in rolled pieces, and grains; alfo frequently cryftallized. The following are its principal figures.

1. Broad fix-fided prifm, nearly equally bevilled on both extremities, and the bevilling planes fet on thofe lateral edges which are formed by the fmaller lateral planes. Sometimes the acute lateral edges are truncated, fometimes alfo bevilled; the obtufe edges are alfo in fome inftances truncated.
2. Very oblique four-fided prifm, flatly bevilled on the extremities, and the bevilling planes fet on the obtufe lateral edges. When the prifm becomes fhort, and two obliquely oppofite bevilling planes increafe fo much as to caufe the others to difappear, a rhomboid is formed.
3. Rectangular four-fided prifm, acuminated by four planes which are fet on the lateral edges; the fummit of the acuminations and lateral edges of the prifm are fometimes truncated.

The cryftals occur fometimes in twin cryftals, and fometimes fcalar-wife aggregated.

The twin cryftals are formed in different ways; one variety is conceived to be formed by two cryftals being

being ſide-wiſe puſhed into each other ; and in another, or what has been called hemitrope, the cryſtal is ſuppoſed to be divided into two, and one half turned completely around and applied to the other, ſo that a re-entering angle is formed at the one extremity, and a ſalient angle at the other.

The cryſtals are ſmall and middle ſized, (particularly the four and ſix ſided priſms) often all around cryſtalliſed in druſes.

Externally its luſtre is ſhining ; internally the principal fracture is ſhining approaching to ſplendent, croſs fracture is glimmering, and both are vitreous, inclining a little to pearly.

Fracture more or leſs perfectly ſtraight foliated, two-fold cleavage, and the folia croſs each other at right angles. Croſs fracture fine grained uneven, paſſing into ſplintery ; parallel with this fracture we obſerve rents that cut the other cleavages obliquely, ſo that the fragments are ſomewhat rhomboidal. Sometimes the foliated is a little curved foliated, and is ſeldom floriformly foliated, which paſſes into a kind of diverging broad radiated.

Occurs in large, coarſe, and ſmall grained diſtinct concretions

More or leſs tranſlucent.

Pretty hard*.

Brittle.

Eaſily frangible.

* Scratches glaſs.—*Hauy*.

Not particularly heavy.

Specific gravity—From 2,272 to 2,594.—According to *Hauy*, from 2,4378 to 2,7045.

For the geognostic and geographic characters see the end of the following description.

Chemical Characters.

It melts without addition before the blowpipe into a white glass.

Constituent Parts.

Silica	62,83	64,0	67,0	43,0	79,0	70
Alumina	17,02	21,0	14,0	37,05	16,0	12
Lime	3,00	6,25		1,70	2,3	
Oxyd of Iron	1,00	2,0		4,0		
Potash	13,00					
Baryt			11,0			8
Magnesia			8,0			9
Loss		3,75				
	96,85		100	85,72	97,3	99
	Vauquelin.*	*Chenevix.*	*Kirwan.*	*Saussure.*	*Meyer.*	*Hassenf.*

* Vauquelin's experiments were made on the green coloured Siberian felspar.

SECOND KIND.

Difintegrated felfpar.

Aufgelöfter feldfpath.—*Werner.*

Its colour is yellowifh and reddifh white, which fometimes verges on grey.

Occurs maffive, diffeminated, and in imbedded cryftals, refembling in figure thofe of frefh felfpar.

Internally its luftre alternates between gliftening, glimmering, and dull.

Fracture in fome varieties is imperfectly foliated, paffing into earthy; in others it is intermediate between uneven, which approaches to fplintery, and earthy.

Fragments indeterminately angular, blunt edged.

It has a tendency to diftinct concretions, but this only when it is paffing to frefh.

Only a little tranflucent on the edges, generally opaque.

Soft, paffing into very foft: alfo femi-hard

Eafily frangible.

Not particularly heavy.

Obſervations.

1. The diſintegrated condition of this kind of felſpar is owing in many inſtances to weathering; but it is alſo highly probable that it is often originally formed in a ſimilar ſtate.

2. It is the link which connects felſpar with porcelain clay.

3. We obſerve a diminiſhing fuſibility from common felſpar through diſintegrated felſpar to porcelain clay, which depends, according to Werner, on the relative proportion of alkali in each.

Geognoſtic Situation of common felſpar.

It is one of the moſt abundant of foſſils. It forms a conſtituent part of granite and gneiſs; it occurs alſo in ſienite, in greenſtone, and in imbedded cryſtals in porphyry, baſalt, and porphyry ſlate. It alſo occurs in beds and kidneys in primitive mountains, and in veins of the oldeſt formation.

Geographic Situation of common felſpar.

It is ſo univerſally diſtributed that we ſhall only mention the localities of a few of the moſt remarkable varieties. The beautiful green coloured variety is found

found in Siberia; the twin cryſtals are found very fine at Baveno, and near to Carſbad in Bohemia; the floriformly foliated in Saxony and the iſland of Arran; the curved foliated in Sweden, and it is found in uncommonly large diſtinct concretions in the iſland of Rona, one of the Hebrides.

THIRD SUBSPECIES.

Adularia.

Adular.—*Werner.*

Moonstone, *Kirw.* vol. 1. p. 322.—Adular. *Estner.* b. 1. s. 525.—*Id. Emm.* b. 1. s. 277.——Adularia, *Nap.* p. 218.—Adulaire, *Lam.* t. 2. p. 194. — *Id. Broch.* t. 1. p. 371 —Feldspath nacre, *Hauy,* t. 2. p. 606.

External Characters.

Its most common colour is greenish white, which often inclines strongly to asparagus green. Sometimes it contains milk white spots that possess a silvery lustre and pearly shine.

It is found massive, in rolled pieces, and crystallized in

1. Oblique four-sided prisms, obtusely bevilled on both ends.
2. Six-sided prisms.
3. Rectangular four-sided prisms, with oblique terminal faces.

The

The cryſtals are longitudinally ſtreaked, middle ſized, large, and very large.

Luſtre of the ſurface is moſtly ſplendent, approaching to pearly.

Luſtre of the principal fracture is ſplendent; the croſs fracture ſhining, and intermediate between vitreous and pearly.

The principal fracture is perfectly ſpecularly foliated, with a two-fold rectangularly interſecting cleavage; croſs fracture ſmall and imperfectly conchoidal.

Fragments rhomboidal.

Has a tendency to thick and ſtraight lamellar diſtinct concretions.

Semitranſparent and tranſlucent.

Hard.

Brittle.

Eaſily frangible.

Not particularly heavy.

Specific gravity.—From 2,500 to 2,600, *Struve.*—2,561. *Morell.*

Chemical Characters.

Before the blow pipe melts without addition into a whitiſh glaſs.

Conſtituent

Constituent Parts.

Silica	64,0	62,50	62,43	64
Alumina	20,0	17,50	19,33	24
Lime	2,0	6,50		6,25
Sulphat of lime			10,98	
Potash	14,0			
Magnesia		6,0	5,50	
Oxyd of iron		1,40		2,00
Sulphat of barytes		2,00		
Water		0,25	1,75	1,75
Loss				3,75
	100,0	96,15	99,99	100
	Vauquelin.	*Vestrumb**.	*Morell* †.	*Chenevix.*

Geognostic Situation.

It is found in veins and cavities in gneiss and mica slate, and is accompanied with quartz, mica, common felspar, and tourmaline.

* Chem. Ann. 1790. b. 2. p. 225.

† Hæpfner. Mag. Helv. t. 2. p. 95.

Geographic

Geographic Situation.

It is found in the mountain of St Gothard in Switzerland, and particularly in the fummit named Adula, whence its name has been derived; alfo in the ifland of Arran*. The variety called moonftone is principally found in the ifland of Ceylon.

Obfervations.

1. The water opal, and girafol of the Italians, and alfo the funftone†, are varieties of adularia, and nearly the fame with moonftone.

2. Adularia is diftinguifhed from common felfpar by its greenifh white colour, particular colour reflection, complete conchoidal crofs fracture, lamellar diftinct concretions, its higher degree of tranfparency, and by the want of thofe rents which crofs the cleavage obliquely in common felfpar.

Werner fufpects that moonftone may be confidered as adularia, becaufe it differs from it by its milk white colour, which is flefh red when held between the eye and the light, and its filvery luftre.

* Mineralogy of the Scottifh Ifles.

† The foffil called funftone has a hyacinth and blood red colour, and a beautiful filvery or pearly reflection: Werner fufpects that it is moonftone artificially coloured.

FOURTH SUBSPECIES.

Labrador Stone.

Labradorſtein.—*Werner.*

Pierre de Labrador, *R. d. L.* t. 2. p. 497.—Variety of common felſpar, *Wid.* p. 335.—Labrador ſtone, *Kirw.* vol. 1. p. 324.—Labradorſtein, *Emm.* b. 1. ſ. 273.—Variety of feldiſpato commune, *Nap.* p. 213.—Labradorite, *Lam.* t. 2. p. 197.—Feldſpath opalin, *Hauy.* t. 2. p. 607.—La pierre de labrador, *Broch.* t. 1. p. 369.

External Characters.

Its principal colour is ſmoke grey, which paſſes into dark aſh and yellowiſh grey. It exhibits, when held in a determinate poſition, a great variety of colours, as blue, green, yellow, red, and brown. Of blue it preſents the following varieties, violet, azure, Berlin, ſky, and ſmalt blue; from the latter it paſſes through verdegris into emerald, graſs, piſtacio, olive, and ſiſkin green; from this it paſſes into ſulphur, lemon and orange yellow, which latter paſſes into

copper

copper red; and feldom pearl grey. In fhort this foffil exhibits all the varieties of green and blue.

The red and yellow colours are the rareft.

It exhibits fpotted and ftriped delineations. Sometimes the fame fpot if held in different directions changes its colour, for inftance, from fky blue to verdegris green, and this into grafs green. Thefe beautiful colours feldom extend over a whole piece, in general they fhew themfelves only in larger and fmaller fpots or patches.

Different colours are prefented according as we hold the piece between the light and the eye, or the eye and the light.

Occurs commonly maffive, in blunt edged pieces and rolled pieces.

Its principal fracture is fhining, paffing into fplendent; the crofs fracture gliftening, and is intermediate between pearly and vitreous.

Fracture perfectly foliated, and the folia crofs each other at right angles.

It occurs ufually in large, coarfe, and feldom in fmall grained diftinct concretions; feldomer in thick and ftraight lamellar diftinct concretions.

Strongly tranflucent.

Not particularly heavy.

In other characters refembles the preceding.

Specific gravity—2,607 to 2,704, *Briffon.*

Chemical Characters.

It is fuſible into a white enamel without addition before the blow pipe.

Constituent Parts.

Silica	69,5
Alumina	13,6
Sulphat of lime	12,0
Oxyd of copper	0,7
—— of iron	0,3

According to Bindheim.

Geognostic Situation.

It forms one of the conſtituent parts of certain kinds of greenſtone, occurs alſo in ſyenite, and is accompanied with mica, ſhorl, and ſeldom with iron pyrites.

Geographic Situation.

It was firſt diſcovered in the iſland of St Paul, on the coaſt of Labrador, where it is ſtill found in conſiderable

ſiderable quantity. It has been alſo found in Ingermannland between Denmark and Norwáy, and near to the romantic lake Baikal in Siberia.

Uſes.

On account of its beautiful colours it is cut for ornamental purpoſes.

Obſervations.

1. Werner ſuppoſes that the changeability of colour by which this ſubſpecies is characteriſed is not original, becauſe it is only obſervable on or near the ſurfaces, never towards the centre of the maſſes. It may be owing to the infiltration of ſea-water*.

2. It is principally diſtinguiſhed from common felſpar by its colour, which is either ſmoke or dark grey, its peculiar changeability of colours, and ſtraight lamellar diſtinct concretions.

3. It was firſt diſcovered by the Moravians, who have a colony on the coaſt of Labrador, about thirty years ago.

* Glaſs by expoſure to the weather, we know, is ſo changed as to reflect a variety of colours.

NINTH

NINTH SPECIES.

Pure Clay.

Reine Thonerde.—*Werner.*

Id. Wern. Cronſt. p. 176,—*Id. Wid.* p 385.—Native Argil, *Kirw.* t. 1. p. 175 —Argilla pura, *Nap.* p. 246.—L'alumine pure, *Broch.* t. 1. p. 318

External Characters.

It is ſnow white, which ſometimes verges on yellowiſh white.

Occurs in ſmall kidney ſhaped pieces.

It has no luſtre.

Fracture very fine earthy.

Fragments indeterminately angular, and very blunt edged.

Opaque.

Soils very little.

Adheres ſlightly to the tongue.

Intermediate between very ſoft and friable.

Light.

Feels fine but meagre.

Constituent

Constituent Parts.

Alumina	45
Sulphat of lime	24
Water	27
Lime, filica and a muriat	4
	100

According to *Fourcroy*. Annales de Muf. *N. A.* t. 1. p. 48.

According to Schreber and Frifchman it contains alumina, mixed with a very little carbonate of lime and filica. Scherer has alfo analyfed it, but I am not acquainted with the refult of his experiments.

Geognostic Situation.

It is found immediately under the foil, accompanied with foliated gypfum and felenite.

Geographic Situation.

Has been found only at Halle in Saxony.

Obfervation.

Obſervation.

Widenmann, from the kind of its repoſitory, and its vicinity to a great laboratory, ſuſpects it to be artificial, and the refuſe of ſome chemical operation. Its external ſhape, however, is a ſufficient proof of its being a natural production; and, I may add, that no laboratory is nearer the ſpot where it is found than a quarter of a league.

TENTH

TENTH SPECIES.

Porcelain Earth.

Porzellanerde.—*Werner.*

Porcelain clay, *Kirw.* vol. 1, p. 178.—Argilla da porcellana, *Nap.* p. 248.—Feldspath argilliforme, *Hauy,* t. 2. p. 616.—La terre a porcelaine, *Broch* t. 1, p. 320.

External Characters.

Its colour is generally reddish white, of various degrees of intensity, which sometimes inclines to yellowish and greyish white.

Occurs massive and disseminated.

Its particles are fine dusty.

Colours strongly.

It is slightly cohering.

Feels fine, but pretty meagre.

Scarcely adheres to the tongue.

Light.

It is of [illegible] importance to [illegible] the [illegible] of this mineral [illegible]

Constituent Parts.

		Earth of Limoges.	
Silica	52	55	62
Alumina	47	27	19
Iron	0,33	0,5	
Water		14	
Lime		2,0	
Magnesia			12
Sulphat of barytes			7,0
	Rose.	*Vauquelin.*	*Hassenfratz.*

Chemical Character.

It is nearly infusible in the greatest heat of a porcelain furnace.

Geognostic Situation.

Sometimes, as at Aue, near Schneeberg in Saxony, porcelain earth occurs in beds in gneiss, and is accompanied with quartz, and sometimes with iron stone. Sometimes it takes the place of felspar in forming one of the constituent parts of granite; we even find large crystals of felspar filled with it. At great depths in the mines of the Freyberg mining field, I have observed beds of gneiss, completely sheltered

ſheltered from every influence of the weather, in which the felſpar was in the ſtate of porcelain earth.

Theſe facts render it probable, that porcelain earth is analogous to felſpar, and that it is a nearly ſimilar ſubſtance, which has been depoſited in a looſer ſtate of aggregation. All porcelain earth, however, has not been formed in this manner; for it is often the reſult of the decompoſition of felſpar, contained in granite or gneiſs.

It is ſtill uncertain whether or not it may not be formed from the decompoſed matter of other rocks.

Geographic Situation.

The fineſt porcelain earth of Saxony, with which the famous porcelain manufactory at Meiſſen is carried on, is brought from Aue. That uſed for manufacturing the fine Berlin porcelain is dug at Gömritz, below Halle, in the diſtrict of Magdeburg; alſo at Zotenberg and Giern in Lower Sileſia. The Auſtrian porcelain is made from a fine earth which is dug at Paſſau; the French porcelain is manufactured with clay dug near Limoges; and the Engliſh is principally manufactured from the porcelain earth of Cornwall.

In China and Japan, where it is called Kaolin, it appears to occur in great quantity, and is uſed for the ſame purpoſes as the European.

In Scotland it occurs in ſmall quantity in the county of Galloway, and in the Mainland, one of the Shetland iſlands.

Uſe.

It uſed alone, or intermixed with other earths, or felſpar for the manufacture of porcelain.

ELEVENTH

ELEVENTH SPECIES:

Common Clay.

Gemeinerthon,—*Werner*.

Werner divides this ſpecies into ſix ſubſpecies, *viz.* 1. Loam. 2. Potters clay. 3. Pipe clay. 4. Variegated clay. 5. Clay ſtone. 6. Slate clay.

FIRST SUBSPECIES.

Loam.

Leim.—*Werner.*

External Characters.

Its colour is yellowiſh grey, and is frequently ſpotted yellow and brown.

Occurs maſſive, and in great maſſes.

It is dull, and ſometimes weakly glimmering, but this only when ſmall ſcales of mica are preſent.

Fracture is in the great uneven, in the ſmall fine earthy.

Fragments are indeterminately angular, very blunt edged.

Colours a little.

Intermediate between looſe and cohering, but more inclining to the firſt.

Adheres pretty ſtrongly to the tongue.

Feels ſlightly greaſy.

Not particularly heavy, approaching to light.

Obſervation.

It is very impure, being mixed with ſand and gravel, and alſo iron ochre. It may be conſidered as ſandy potter's clay, mixed with mica and iron ochre.

SECOND SUBSPECIES.

Potters Clay.

Töpferthon.—*Werner*.

This ſubſpecies is by Werner divided into two kinds, the *a*. Earthy, and *b*. Slaty.

a. Earthy

FIRST KIND.

Earthy potters Clay.

External Characters.

It colours are yellowiſh and greyiſh white; alſo greeniſh, blueiſh and ſmoke grey, and theſe colours are of various degrees of intenſity. The greeniſh grey ſometimes paſſes into mountain green, but this is rare.

Occurs maſſive, and in conſiderable maſſes.

Fracture in the ſmall pretty fine earthy, in the great coarſe grained uneven.

Fragments indeterminately angular, blunt edged.

Opaque.

Colours a little.

Very ſoft paſſing to looſe.

Adheres ſtrongly to the tongue.

Feels a little greaſy.

Not particularly heavy, approaching to light.

SECOND KIND.

Slaty potters Clay.

External Characters.

Its colour is dark aſh grey, but it ſometimes alſo falls into brown.

Its principal fracture is imperfectly conchoidal, the croſs fracture earthy.

Fragments indeterminately angular and tabular.

Light, verging on not particularly heavy.

Feels more greaſy than the preceding.

In other characters it agrees with the earthy.

Geognostic Situation.

It occurs in great rock maſſes, and in beds in alluvial land. Many of the mineral veins in primitive mountains are lined with it.

Geographic Situation.

It is very univerſally diſtributed.

Uſe.

As it forms a paſte with water, and can be baked without cracking, it is uſed in potteries, for the manufacture of the common kinds of earthen ware. It is alſo made into bricks and tiles, and is uſed in founderies for lining crucibles to preſerve them from fuſion; in ſmelting houſes, to aſſiſt the fuſion of calcarious ores; and by the agriculturiſt for the improving of ſandy ſoils.

Obſervation.

It is compoſed of the fineſt part of the detritus of decompoſing rocks, as of granite, gneiſs, porphyry, &c. which is waſhed down by great rains and floods, and afterwards depoſited in ſtill places.

THIRD SUBSPECIES.

Pipe Clay.

Pfeifenthon.—*Werner*.

External Characters.

Its colour is greyifh white paffing into yellowifh white, and both fall ftrongly into grey.

Occurs maffive.

Luftre glimmering.

Fracture in the fmall, fine earthy; in the large, coarfe and fine grained uneven.

Fragments indeterminately angular, fharp-edged.

Streak fhining.

Intermediate between loofe and coherent, but more generally coherent.

Adheres pretty ftrongly to the tongue.

Feels rather greafy.

Eafily frangible.

Light, paffing into not particularly heavy.

FOURTH SUBSPECIES.

Variegated Clay.

Bunterthon.—*Werner.*

External Characters.

White, red, and yellow are its chief colours. Of white, the only variety is yellowiſh white, which paſſes into ochre yellow, and ſometimes into yellowiſh brown. The varieties of red are, reddiſh white, which paſſes into pearl grey, fleſh red, and peach bloſſom red.

It is marked with ſtriped, veined, and ſpotted delineations.

Occurs maſſive.

Fracture earthy, and then it has no luſtre; ſometimes has a tendency to ſlaty, then it is glimmering.

Its ſtreak is ſhining.

Very ſoft, paſſing into friable.

Feels a little greaſy.

Adheres a little to the tongue.

Mild.

Light, paſſing into not particularly heavy.

Geographic

Geographic Situation.

It is found at Wehraw in Upper Luſatia.

Obſervations.

1. It does not form ſo kneadable a maſs as the preceding.

2. It is the link which connects clay with lithomarge, and ſtands between it and pipe clay.

FIFTH SUBSPECIES.

Clayſtone.

Thonſtein.—*Werner.*

External Characters.

Its moſt common colours are grey and red. Of grey it preſents the following varieties: greeniſh, bluiſh, aſh, ſmoke, and pearl grey; from pearl grey it paſſes into browniſh red. It is ſometimes marked by yellowiſh brown ſpotted and ſtriped delineations.

It occurs maſſive.

It is dull.

Fracture generally fine earthy, which ſometimes paſſes into fine grained even, ſometimes into ſlaty, and even ſplintery; ſome varieties are flat conchoidal, with a tendency to ſlaty.

Fragments indeterminately angular, ſeldom tabular, and not particularly ſharp edged.

It is opaque.

Soft, approaching to very ſoft.

Not particularly brittle.

Pretty eaſily frangible.

Does not adhere to the tongue.

Feels rather meagre.

Geognoſtic

Geognostic Situation.

It forms vaſt rock maſſes, occurs in beds, in veins, and makes the baſis of clay porphyry. It is found accompanying the neweſt porphyry formation, alſo in beds and veins in the independent coal formation.

Geographic Situation.

It is found in Saxony, as at Chemnitz, Stolberg, and the Windberg in the Plauiſchen Grunde near to Dreſden; alſo in Scotland, as in the Pentland Hills near Edinburgh, and the Iſland of Papa Stour, one of the Shetlands.

Obſervations.

It paſſes ſometimes into potters clay, ſometimes into ſlate clay, and alſo into jaſper. It probably alſo paſſes into compact felſpar; the reaſons for this ſuppoſition will be fully explained in the Geognoſie, where I ſhall have an opportunity of detailing ſeveral new and intereſting facts reſpecting this foſſil, conſidered as conſtituting a particular formation.

SIXTH SUBSPECIES.

Slate Clay.

Schieferthon.—*Werner.*

Slate clay, ſhale, *Kirw.* t. i. p. 182.—L'Argile ſchiſteuſe, *Broch.* t. i. p. 327.

External Characters.

Its colour is grey, of which it preſents the following varietes; ſmoke grey, yellowiſh grey, and aſh grey, which latter ſometimes approaches to blueiſh grey. From aſh grey it paſſes into greyiſh black.

It is maſſive.

Internally it is dull, but when it contains intermixed mica it is glimmering.

Fracture more or leſs perfectly ſlaty, ſometimes approaching to earthy.

Fragments indeterminately angular and tabular.

It is opaque.

Intermediate between ſoft and very ſoft.

Mild.

Eaſily frangible.

Not

Adheres a little to the tongue.

Feels meagre.

Not particularly heavy, approaching to light.

Specific gravity.—According to *Kirwan*, from 2,600 to 2,680.

Geognostic Situation.

It occurs in beds and ſtrata? It is an almoſt conſtant attendant of coal; and it is found alſo in the neweſt floetz trap and alluvial formations.

Geographic Situations.

It is found generally wherever the coal, floetz trap, and alluvial formations occur, ſo that its diſtribution is univerſal.

Obſervations.

1. According to its external characters it ſtands between potters clay and clay ſtone, and ſometimes (particularly the dark variety) paſſes into bituminous ſhale.

2. It is ſufficiently diſtinguiſhed from clay ſlate by its colour, inferior hardneſs and weight; its adheſion

to the tongue, and its becoming ſoft, and breaking in water.

3. It very often contains carboniſed and bituminated vegetable impreſſions, which generally belong to ferns and reeds.

TWELFTH SPECIES.

Polier, or Poliſhing Slate.

Polierſchiefer.—*Werner.*

External Characters.

Its colour is yellowiſh grey, which approaches to cream yellow and yellowiſh white.

It is always ſtriped, and the colours alternate in layers.

Occurs only maſſive.

Internally it is dull.

Its principal fracture is ſlaty, the croſs fracture earthy.

Fragments generally tabular.

Very ſoft paſſing into ſoft.

Adheres to the tongue.

Feels fine but meagre.

Not particularly heavy, approaching to light, even nearly ſwimming. It is lighter than tripoli.

Geognostic Situation.

It is found in the vicinity of pseudo volcanos, and is supposed by Werner to be the ashes of coal, which have been washed down into the lower grounds, and deposited in a regular form. This opinion will be illustrated and explained in the geognosie.

Geographic Situation.

Has been hitherto found only in Bohemia.

Observations.

Brochant has followed several of the German mineralogists in considering the fossil of Menil Montant near Paris as identical with the polier slate of Werner. It differs from it, however, not only in oryctognostic, but in geognostic characters*.

* We have to expect from Daubisson, the only Frenchman who has studied the Wernerian geognosie, an account of the interesting country in the vicinity of Paris. The occurrence of the peculiar fossil, erroneously called polier slate, with its imbedded tuberose semi-opal, the superincumbent gyps, containing remains of quadrupeds, shew that the rocks in that quarter constitute a peculiar formation, different from any described by Werner. It is probably newer than the newest flötz trap, and nearly cotemporaneous with the Wehrauer formation of limestone and ironstone, which lies over alluvial land.

THIRTEENTH SPECIES.

Tripoli.

Trippel.—*Werner.*

Tripela, *Wall.* t. 1. p. 94.—Trippel, *Wid.* p. 353.—Tripoli, *Kirw.* vol. 1. p. 202. *Id. Eſtner,* b. 2. ſ. 631. *Id. Emm.* b. 1. ſ. 307.—*Id. Nap.* p. 210.—*Id. Lam.* t. 2. p. 457.—Le Tripoli, *Broch.* t. 1. p. 379.—Lava coctile tripoleene et thermantide tripoleene, *Hauy,* t. 4. p. 469.

External Characters.

Its colour is yellowiſh grey, which paſſes into aſh grey.

Occurs only maſſive.

Internally it is dull.

Fracture pretty coarſe earthy.

Fragments indeterminately angular, and blunt-edged.

Very ſoft, approaching to friable.

Feels meagre and rough.

Does not adhere to the tongue.

Not particularly heavy, approaching to light.

Geognostic Situation.

Occurs in veins and beds in floetz rocks, and probably alſo in alluvial land.

Geographic Situation.

It is found in beds in the coal works of Thuringia; in thoſe of Potſchappel near Dreſden; in Derbyſhire, it occurs in veins; in Tripoli, (from whence it was firſt brought and derived its name), where it alſo forms veins. It is ſaid to be alſo found in Ruſſia, Weſtphalia, Flanders, Heſſia, Bohemia, and Switzerland.

Uſe.

When reduced to powder, it is employed for poliſhing metals, marbles, and other minerals. It is alſo uſed for poliſhing glaſs.

Obſervations.

1. It was at one time believed to be a volcanic product, but the aſſertion is now fully diſproved.

2. It appears to be an extremely fine mixture of clay and ſand.

FOURTEENTH SPECIES.

Alumſtone.

Alaünſtein.—*Werner.*

Calcareus aluminaris albus, *Wall·* t. 2. p. 34.—Alaunſtein, *Wid.* p. 399.—Pietra d'allume, *Nap.* p. 266.—Aluminilite, *Lam.* t. 2. p. 113.—La pierre alumineuſe, *Broch.* t. 1. p. 381.

External Characters.

Its colour is ſometimes greyiſh white, ſometimes light yellowiſh grey.

Occurs maſſive, and in conſiderable maſſes.

Shews a tendency to cryſtallization.

Internally it is dull.

Fracture uneven, approaching to fine earthy.

Fragments

Fragments indeterminately angular, blunt edged.

Soft, paſſing to friable.

Light.

Although Werner has given the preceding deſcription as that of alumſtone, he does not venture to affirm that he has deſcribed the true Roman alum ſtone, as it is extremely difficult to procure ſpecimens of it, its exportation being forbidden by the moſt ſevere puniſhments.

Geographic Situation.

It is found at Tolfa near Rome, where it is ſaid to form a whole hill. Werner has alſo a ſpecimen which is ſaid to have been found in Hungary.

Obſervation.

Werner ſuppoſes that it is intermediate between clayſtone and limeſtone, from the reſemblance it bears to both of theſe foſſils.

Uſe.

From the alum ſtone of Tolfa the famous Roman alum is manufactured.

FIFTEENTH SPECIES.

Alum earth.

Alaunerde.—*Werner.*

Terra aluminaris, *Wall.* t. 2. p. 32.—Alaunerde, *Wid.* p. 398.—*Id. Eſtner*, b. 2. ſ 647. *Id. Emm.* b. ſ. 299.—Aluminite bitumneux, *Lam.* t. 2. p. 116. — La terre alumineuſe, *Broch.* t. 1. p. 383.

External Characters.

Colour blackiſh brown and browniſh black.

Maſſive.

Dull, ſometimes glimmering, but this probably owing to an intermixture of mica.

Fracture earthy, with a tendency to ſtraight ſlaty.

Breaks into tabular pieces.

Streak ſhining.

Feels a little meagre, and ſomewhat greaſy.

Mild.

Intermediate between very ſoft and friable.

Light.

Chemical Character.

When expofed to heat it burns with a flame, and when left fome time expofed to a moift atmofphere it becomes warm, and at length takes fire.

Geognostic Situation.

It occurs frequently in beds of great magnitude, in alluvial land, and fometimes alfo in the floetz trap formation.

Geographic Situation.

It is found in Bohemia, Saxony, Auftria, Naples, Hungary, and in the Vivrais in France.

Ufe.

It is lixiviated to obtain the alum it contains; it is even fometimes ufed for fuel.

Obfervations.

Obſervations.

1. It bears a ſtrong reſemblance to bituminous wood, and probably paſſes into it. May it not be conſidered as a ſubſpecies of bituminous wood?

2. We muſt be careful not to confound it with alum ſtone or alum ſlate, from which it differs very much.

SIXTEENTH SPECIES.

Alum Slate.

Alaunſchiefer.—*Werner.*

Werner divides this ſpecies into two ſubſpecies 1. Common alum ſlate. 2. Gloſſy alum ſlate.

FIRST SUBSPECIES

Common Alum Slate.

Gemeiner Alauufchiefer.—*Werner.*

Schiftus aluminaris? *Wall.* t. 2. p. 32.—Variety of alum flate, *Wid.* p. 396.—Alaunfchiefer, *Eſtner*, b. 2. f. 651. —Gemeiner alaunfchiefer, *Emm.* b. 1. f. 296.—Schifto aluminofo, *Nap.* p. 264.—Variété de l'argile fchifteufe, *Hauy.*—Le fchifte alumineux, commun, *Broch.* t. 1. 386.

External Characters.

Its colour is intermediate between greyifh and bluifh black, which falls ftrongly into grey.

Occurs maffive, and fometimes in balls, which are immerfed in the maffive.

Internally it is more or lefs glimmering.

Fracture pretty perfectly ftraight flaty.

Fragments tabular.

Retains its colour in the ftreak, but becomes a little fhining.

Soft.

Not

Not particularly brittle.
Eafily frangible.
Not particularly heavy.

Chemical Characters.

When expofed to the air it acquires a fweetifh aluminous tafte, and efflorefces.

SECOND SUBSPECIES.

Gloſſy Alum Slate.

Gläzaender Alaunſchiefer.—*Werner*.

Variety of Alaunſchiefer, *Wid.* p. 395.—Glänzender a. ſchiefer, *Emm.* p. 297.— Alaunſchiefer, *Eſlner*, b. 2. ſ. 651.——Varieté de l'argile ſchiſteuſe, *Hauy*.——La ſchiſte alumineux eclatante, *Broch.* t. 1. p. 388.

External Characters.

Colours intermediate between bluiſh and iron black. On the rents it is marked with a tempered ſteel and peacock-tail tarniſh.

Occurs maſſive.

The luſtre of its principal fracture is ſhining, gliſtening and ſemi-metallic. Croſs fracture glimmering.

Fracture pretty ſtraight, and partly waved, ſlaty.

Fragments tabular, and often run into wedge-ſhaped.

In other reſpects reſembling the former, only a little more aluminous.

Geognostic

Geognostic Situation of Alum Slate.

It occurs in beds and ſtrata, which are ſubordinate to the neweſt clay ſlate, and alſo in tranſition mountains. It ſometimes, although rarely, forms veins.

Geographic Situation.

It occurs in Saxony, Bohemia, Hungary, France, Scotland, as in the valley of the lead hills, in the high mountains in the neighbourhood of Moffat, and in many other places among the great maſs of tranſition rocks in the ſouth of Scotland. Eſmark obſerved, at Felſobanya in Hungary, a vein of alum ſlate about two fathoms wide.

Uſes.

Alum earth, as already mentioned, by expoſure to the influence of the weather affords alum; but this ſpecies, before it yields alum muſt be burnt. Beſides alum earth, alum ſtone, and alum ſlate, other foſſils afford alum; thus ſome varieties of foſſil coal are pretty productive, and at Schonen in Sweden it is prepared from a variety of bituminous ſhale.

Obſervations.

Obſervations.

1. Alum earth is diſtinguiſhed from alum ſlate by its browniſh black colour, want of luſtre, inferior hardneſs and inflammability.

2. At Whitby in Yorkſhire, there are very extenſive alum mines; but we are as yet ignorant, not only of the ſpecies of the foſſil from which the alum is obtained, but alſo of the formation to which it belongs.

SEVENTEENTH SPECIES.

Bituminous Shale.

Brandſchiefer.—*Werner*.

Schiſtus pinguis? *Wall*. t. 1. p. 354.—Schiſtuscarbonarius, *Id.* p. 358.—Brandſchiefer, *Wid.* p. 394.—Bituminous ſhale, *Kirw.* vol 1. p, 183.—*Eſtner*, b. 2. ſ. 658. *Emm.* b. 1. ſ. 289.—Shiſto bituminoſo, *Nap.* p. 263.—Argilite bitumineux, *Lam.* t. 2. p. 116.—Varieté de l'argile ſchiſteuſe, *Hauy*.—Leſchiſte bituminenx, *Broch*, t. 1. p. 389.

External Characters.

Its colour is browniſh black.

Occurs only maſſive.

Internally its luſtre is glimmering.

Fracture pretty perfectly ſtraight, but ſomewhat thin, ſlaty.

Fragments tabular.

Streak ſhining; but its colour is not altered.

Very ſoft.
Rather mild.
Feels rather greaſy.
Eaſily frangible.
Not particularly heavy, approaching to light.

Chemical Character.

When laid on burning coal it emits a pale flame, ſulphureous odour, and black ſmoke, becomes white, and loſes a conſiderable portion of its weight.

Geognostic Situation.

It occurs along with ſlate clay, in the coal formation. It paſſes on the one hand into coal, on the other into ſlate clay.

Geographic Situation.

It is found in Bohemia, Poland, Sileſia, England, Scotland, and in general wherever the independent coal formation makes its appearance.

Obſervation.

Obſervations.

1. In this ſpecies the clay is combined with bitumen, but in alum ſlate with carbone.

2. It is the ampelitis of the ancients.

EIGHTEENTH SPECIES.

Drawing Slate, or black Chalk.

Zeichenschiefer.—*Werner.*

Schistus pictorius nigrica, *Wall.* t. 1. p. 358.—Zeichenschiefer, *Wern. Cronst.* p. 206. — Black chalk, *Kirw.* vol. 1. p. 195.—Schwartze kreide, *Estner*, b. 2. s. 661, —Schiefer, *Id. Emm.* b. 1. s. 303. — Schisto pittorio, *Nap.* p. 269.—Melantirite ou crayon noire, *Lam.* t. 2. p. 112.—Argile schisteuse graphique, *Hauy*, t. 4. p, 447. —Le schiste a dessiner, *Broch.* t. 1. p. 391.

External Characters.

Its colour is greyish black, which sometimes approaches to blueish black.

Massive.

Lustre of the principal fracture is glimmering, but the cross fracture dull.

Principal fracture generally slaty, the cross fracture fine earthy.

Fragments

Fragments generally tabular, and ſometimes ſplintery.

Opaque.

Colours and writes.

Its ſtreak is gliſtening, but does not alter the colour.

Soft, paſſing into very ſoft.

Mild.

Eaſily frangible.

Feels meagre but fine.

Not particularly heavy, approaching to light.

Chemical Characters.

According to Lelievre before the blow pipe and without addition becomes covered with a ſlight varniſh.

Constituent Parts.

Silica	64,0
Alumina	11,25
Carbone	11,0
Oxyd of iron	2,75
Water	7,50
	96,35

According to *Wiegleb. Crells. Ann.* 1797. ſ. 485.

Geognostic

Geognostic Situation.

It occurs in primitive mountains, and is ſubordinate to clay ſlate. It is uſually accompanied by alum ſlate, with which it is indeed nearly allied.

Geographic Situation.

It is found in France, Bareuth, Spain, Italy, Iceland and Scotland, as in the iſland of Iſla, one of the Hebrides*.

Uſe.

When of a middling degree of hardneſs it is uſed for drawing. The beſt is ſaid to be found in Spain and Italy.

Obſervation.

It burns red.

* Mineralogy of e Scottiſh iſles.

NINETEENTH

NINETEENTH SPECIES.

Whet Slate.

Wetzſchiefer.—*Werner.*

Schiſtus coticula, *Wall.* t. 1. p. 353.—Wetzchiefer, *Wid.* p. 402.—Novaculite, *Kirw.* vol. 1. p. 238.—Wetzchiefer, *Eſtner*, b. 2. ſ. 664. *Id. Emm.* b. 1. ſ. 305.—Pietra cote, *Nap.* p. 270.—Cos. *Lam.* t. 2. p. 105—Le ſchiſte a aiguiſer, *Broch*, t. 1. p. 393.—Argile ſchiſteuſe novaculaire, *Hauy*, t. 4. p. 448.

External Characters.

Its moſt common colour is greeniſh grey, it occurs alſo mountain, aſparagus, olive, and oil green.

Maſſive.

Internally weakly glimmering, almoſt dull.

Fracture is in the large ſlaty, in the ſmall ſplintery.

Fragments tabular.

Tranſlucent on the edges.

Semihard, paſſing into ſoft.

Feels rather greaſy.

Not particularly brittle.

Not

Not particularly heavy.

Specific gravity—2,722.

Geognostic Situation.

It occurs in primitive mountains, and is ſubordinate to clay ſlate.

Geographic Situation.

It is found at Lauenſtein in the Margraviate of Bareuth, in Saxony, as at Seiferſdorf near Freyberg, in Bohemia, and the Levant, from whence it was firſt brought and made known in Europe.

Uſe.

When cut and poliſhed it is uſed for ſharping knives and other inſtruments.

Obſervations.

1. Werner ſuſpects, from its green colour, greaſy feel, and its paſſing into indurated talc, that it contains magneſian earth.

2. This

2. This ſpecies does not include every kind of whetſtone which is in uſe, for ſome are of clay ſlate, or compact limeſtone, others are of ſandſtone.

3. It is diſtinguiſhed from all other ſlaty foſſils by its fracture.

TWENTIETH SPECIES.

Clay Slate.

Thonſchiefer.—*Werner.*

Schiſtus ardeſia tegularis, *Wall.* t. 1, p. 351.—Thonſchiefer, *Wid.* p. 391.—Argillite, *Kirw.* t. 1, p. 234.— Killas, *Id.* p. 237. *Id. Emm.* t. 1. p. 284. *Eſtner*, b. 2. ſ. 667. Ardoiſe, *Lam.* p. 110.—Le ſchiſte argileux, *Broch.* t. 1, p. 395 —Primitive ſchiſtus of mineralogiſts.

External Characters.

Its principal colour is grey, of which the varieties are yellowiſh, bluiſh, greeniſh*, ſmoke, aſh and pearl grey. The ſmoke, bluiſh, and aſh grey are the moſt common. From greeniſh grey it paſſes into a kind of blackiſh green; from dark ſmoke grey it paſſes into greyiſh black, and from pearl grey into browniſh red.†

* The greeniſh varieties ſeem to be verging on talc ſlate.

† Houſes roofed with this variety appear as if covered with copper.

Sometimes

Sometimes ſpotted.

Occurs maſſive.

Internally its luſtre is gliſtening, bordering on ſhining, and ſometimes glimmering, and is reſinous approaching to pearly.

Fracture more or leſs ſlaty, and ſome varieties approach to foliated, and others to compact. The ſlaty is either ſtraight or undulatingly curved and the latter has a two-fold obliquely interſecting cleavage*.

Fragments tabular, and alſo large ſplintery †.

Affords generally a greyiſh white ſtreak.

Opaque.

Soft.

Very mild.

Some varietes feel a little greaſy.

Pretty eaſily frangible.

Not particularly heavy.

Geognostic Situation.

It occurs in vaſt ſtrata in primitive and tranſition mountains, and Werner obſerved two mighty veins of it in the mountains of Schneeberg, and others in the mountains of Hartenſtein.—*Wern. Gänge.*

* In the foreſt of Tharand, in Upper Saxony, I obſerved clay ſlate which appeared to be compoſed of globular, and theſe again of concentric lamellar diſtinct concretions.

† The large ſplintery is named ſplinter ſlate.

Geographic Situation.

It is found very univerſally diſtributed ; hence its localities are very numerous ; we ſhall therefore only mention a few of thoſe of Scotland. At Eaſdale and the neighbouring iſles there are great depoſitions of tranſition ? clay ſlate : between Elvanfoot and Moffat there are ſtrata of tranſition ſlate, which alternate with grey wacce ; near the Crook, between Edinburgh and Moffat, there are quarries ſituated in the ſame ſpecies of rock ; and in many other parts of the great chain of mountain groupes that traverſe the ſouth of Scotland it is to be found. The clay ſlate of Balychuliſh in Argyleſhire, as far as I can judge from ſpecimens and information, appears on the contrary to belong to the primitive rocks.

Uſe.

When it ſplits into thin and firm tables it is employed for roofing houſes. The greyiſh black ſtraight ſlaty variety is uſed for writing on ; and the ſplintery for pencils, and ſome varieties are ſo firm that they can be uſed as whet-ſtones.

Obſervation.

Obſervations.

1. It is to be obſerved paſſing into ſeveral congenerous foſſils; thus the oldeſt primitive clay ſlate has a conſiderable degree of luſtre, ſhews a beginning ſcaly aſpect, and paſſes into mica ſlate; the greeniſh varieties, by an increaſe of their proportion of magneſian earth, and conſequent alteration of external characters, paſs into whet ſlate, chorite ſlate, and indurated talc. It may even paſs into ſlate clay, but I do not know that this has ever been obſerved.

2. In places where the ſplintery variety is found, the ſeparated maſſes appear like rotten wood.

TWENTY-

TWENTY-FIRST SPECIES.

Lepidolite.

Lepidolith,—*Werner.*

Id. Wid. p. 378. *Id. Kirw.* vol. 1. p. 208. *Id Emm.* b. 3. f. 324. *Id Eſtner,* b. 2. f. *Id Nap.* p. 167. *Lam.* t. 2. p. 315. *Broch.* t. 1. p. 399.

External Characters.

Its colour is a kind of peach-bloſſom red that verges on lilac blue; it alſo paſſes into pearl grey and yellowiſh grey. The yellowiſh grey colour is however probably only accidental, and owing to the loſs of the colouring matter.

Occurs maſſive.

Internally its luſtre is gliſtening, paſſing into ſhining.

Fracture in the ſmall foliated, in the great ſplintery.

Fragments indeterminately angular, blunt edged.

Occurs in ſmall and fine grained diſtinct concretions.

Tranſlucent.

Mild.

Soft.
Eafily frangible.
Not particularly heavy.
Specific gravity.—*Klaproth,* 2,816.—*Haüy,* 2,854.

Chemical Characters.

Before the blow pipe it melts eafily without intumefcence, into a white femitranfparent, veficular enamel.

Constituent Parts.

Silica	54,50	54,0
Alumina	38,25	20,0
Oxyd of iron	75	1,0
—— of Manganefe	75	3,0
Potafh	4,0	18,0
Fluat of Lime		4,0
Lofs	2,50	
	100	100

According to *Klaproth,* b. 2. f. 195. *Vauquelin. I. d. M.* N° 51. p. 235.

Geognostic

Geognostic and Geographic Situations.

It has been hitherto found only at Rozena in Moravia, where it lies in gneifs, but whether it is of cotemporaneous or pofterior formation, I do not know. It appears fometimes to be intermixed with fcales of of mica.

Obfervations.

1. It was at firft confidered as a fubfpecies of zeolite, afterwards as a variety of foliated gypfum, and fome continue to arrange it with mica.

2. The fuppofed cryftallized variety is red coloured fchorlous beryll.

TWENTY-

TWENTY-SECOND SPECIES.

Mica or Glimmer.

Glimmer.—*Werner.*

Mica, *Wall.* t. 1. p. 383.—Glimmer, *Wid.* p. 403.—Mica, *Kirw.* vol. 1, p. 210.—Glimmer, *Eſtner*, b. 2. ſ. 673. *Id. Emm* b. 1. ſ. 31. *Id. Lam* p. 337.—Mica, *Nap.* p. 272.—Le Mica, *Broch.* t. 1. p. 402.

External Characters.

Its moſt common colour is grey, from which it paſſes on the one ſide into brown, on the other into black. Of grey it preſents the following varieties, yellowiſh, aſh, and greeniſh grey, which latter paſſes into blackiſh green; the yellowiſh grey paſſes on the other ſide into ſilver white, and into pinchbeck brown and browniſh black.

Occurs maſſive, diſſeminated, in thin tables and layers in other ſtones, alſo cryſtallized.

1. In equilateral ſix-ſided tables, with ſmooth terminal and lateral planes.

2. In fix-fided prifms.

The cryftals are generally fmall, feldom middle-fized, and either interfect one another, and form drufes, or are fingly imbedded.

Surface of the cryftals fplendent; internally the luftre is fhining and fplendent, generally pearly and refinous, and in fome varieties femi-metallic, even fometimes paffing into metallic.

Fracture perfectly foliated, fingle cleavage, commonly undulatingly curved foliated, fometimes plane foliated, alfo floriformly and diverging radiated, and the rays plumofely ftreaked.

Fragments generally tabular, and indeterminately angular.

The maffive fometimes occurs unfeparated, but the foliated in coarfe and fmall grained diftinct concretions; the radiated occurs in wedge-fhaped prifmatic concretions.

In thin plates it is tranfparent, but in larger pieces only tranflucent on the edges.

Semi-hard paffing into foft.

Mild.

Feels fmooth but not greafy.

More or lefs eafily frangible.

Elaftically flexible.

Not particularly heavy.

Specific gravity—*Blumenbach*, 2,934.—*Briffon*, 2,79

Chemical

Chemical Character.

According to Lelievre it is converted with difficulty into an enamel, when expofed to the blow pipe.

Constituent Parts.

Silica	40	38	50
Alumina	46	28	35
Oxyd of iron	9	14	7,0
Magnefia	5	20	1,35
Lime			1,33
Lofs			5,32
	100	100	100
	Bergman.	*Kirwan.*	*Vauquelin.*

Geographic Situation.

It is one of the conftituent parts of granite, gneifs and mica flate, and it is alfo fometimes found in fyenite, porphyry, and wacce. Notwithftanding its occurrence in wacce it is to be confidered as nearly peculiar to the primitive mountains, what is found in the newer formations being evidently derived from primitive rocks by difintegration.

Geognostic Situation.

It is found wherever the rocks already mentioned occur, which is in almoſt every quarter of the globe.

Uſe.

It was formerly uſed inſtead of glaſs for windows and lanterns, and till very lately it was uſed in the Ruſſian navy, as its great elaſticity rendered it leſs liable than glaſs to break on the diſcharge of cannon. The mica for this purpoſe was dug in the neighbourhood of Irkutſk and Ilmena in Siberia.

Obſervation.

The blackiſh green variety is the link which connects it with chlorite ſlate.

TWENTY-

TWENTY-THIRD SPECIES.

Pot Stone.

Topfstein.—*Werner.*

External Characters.

Its colour is greenifh grey, of different degrees of intenfity; the deeper varietes pafs to leek green.

Occurs maffive.

Luftre internally gliftening and pearly.

Fracture fometimes curved foliated, fometimes imperfectly flaty.

Fragments tabular.

The foliated fhews imperfect coarfe and fine grained diftinct concretions.

Tranflucent on the edges, and fometimes opaque.

Soft, and fometimes very foft.

Nearly mild.

Feels greafy.

Very difficultly frangible.

Geognostic Situation.

It is found in beds along with ſerpentine ? or nidular in it.

Geographic Situation.

It is found at Como in the Griſons, and an imperfect kind at Zöblitz in Saxony. It is ſaid to be found in Hudſon's Bay.

Obſervations.

1. It is very neary allied to indurated talc, with which it nſed formerly to be confounded.

2. As it is very refractory in the fire it can be uſed for the lining of furnaces, and as it is eaſily turned, various culinary veſſels may be made of it.

TWENTY-FOURTH SPECIES.

Chlorite.

Chlorit.—*Werner*.

This ſpecies is divided by Werner into four ſub-ſpecies, *viz.* 1. Chlorite earth. 2. Common Chlorite. 3. Foliated Chlorite. 4. Chlorite Slate.

FIRST

FIRST SUBSPECIES.

Chlorite Earth.

Chlorit erde.—*Werner.*

External Characters.

Its colour is intermediate between dark mountain green and blackiſh green.

It is compoſed of ſmall pearly glimmering ſcaly particles; it even occurs looſe.

It is very coherent; gives a mountain green and ſhining ſtreak.

Colours a little.

Feels rather greaſy.

Not particularly heavy, almoſt light.

Geognostic Situation.

occurs in primitive mountains, and principally ..n clay ſlate.

Geographic

Geographic Situation.

It is found in Saxony, at Altenberg and Ehrenfriederfdorf, in Switzerland and Savoy.

Obfervation.

It bears a ftriking refemblance to green earth.

SECOND SUBSPECIES.

Common Chlorite.

Gemeiner Chlorit.—*Werner.*

External Characters.

Colour blackifh green, which approaches to mountain green.

Occurs maffive and diffeminated.

Internally its luftre is glimmering and gliftening.

Fracture foliated, and very fine foliated paſſing into earthy.

Fragments indeterminately angular, blunt-edged.

Colour of the ſtreak lighter green.

Soft, bordering on very ſoft.

Opaque.

Mild.

Feels rather greaſy.

Eaſily frangible.

Not particularly heavy.

Geognostic Situation.

It is frequently found in metaliferous veins; and alſo in none metallic veins of the oldeſt formation.

Geographic Situation.

Is found in the Stockwerkes of Geyer and Altenberg in Saxony, and iu Zinnwald.

THIRD SUBSPECIES.

Chlorite Slate.

Chlorite Schiefer.—*Werner.*

External Characters.

Its colour is blackifh green, of various degrees of intenfity.

Only maffive.

Internally it is gliftening and refinous.

Fracture fometimes curved, fometimes undulatingly flaty; fome varieties pafs to fcaly foliated, and thofe have the greateft degree of luftre.

It has a two-fold cleavage.

Fragments flaty.

Opaque.

Gives a mountain green ftreak, and changes its luftre a little.

Perfectly mild.

Feels rather greafy.

Not particularly heavy, heavier than common chlorite.

Geognoſtic Situation.

It is one of the newer primitive rocks, and occurs in beds ſubordinate to clay ſlate.

Geographic Situation.

It is found in Norway, Sweden, Stiria, the Tyrol, Switzerland, in Scotland, in the iſlands of Arran and Bute, banks of Loch Lomond, Loch Tay, &c*.

Obſervations.

1. It ſometimes paſſes into mica ſlate, and hornblende ſlate.

2. It very frequently contains imbedded octaedral cryſtals of magnetic iron ſtone, often alſo garnets. The occurrence of magnetic iron ſtone is characteriſtic of this ſubſpecies.

* Mineralogy of the Scottiſh iſles.

FOURTH SUBSPECIES.

Foliated Chlorite.

Blättriger Chlorit.—*Werner.*

External Characters.

Colour is intermediate between dark mountain and blackiſh green.

Occurs maſſive, diſſeminated, but almoſt always cryſtallized.

1. Six-ſided table.
2. Cylinder terminated by two cones.
3. Two truncated cones joined baſe to baſe.

If we ſuppoſe the ſix-ſided table N° 1. to revolve around an axis which paſſes through its two oppoſite angles, the figure N° 2. will be formed; but if it revolves around an axis which paſſes through the two oppoſite ſides, the figure N° 3. will be produced.

Externally the ſurface is ſtreaked and gliſtening.

Cryſtals are generally ſmall and middle ſized, and occur ſingly implanted.

Internally its luſtre is ſhining and pearly, approaching to reſinous.

Fracture

Fracture foliated, generally curved foliated, simple cleavage.

Fragments tabular.

Translucent on the edges, or opaque.

Soft, passing into very soft.

Mild.

The folia are commonly flexible.

Feels rather greasy.

Easily frangible.

Not particularly heavy.

The streak is lighter.

Constituent Parts.

Silica	0,350	0,
Magnesia	0,299	0,
Alumina	0,180	0,
Oxyd of iron	0,97	0,
Water	0,27	0,
	953	

Lampadius' handbuch zur chemischen analyse der mineral Körper, s. 229.

Geognostic Situation.

Occurs in veins of the oldest formation that traverse granite, gneiss, and mica slate,

Geographic

Geographic Situation.

It has been hitherto found only on the mountain of St. Gothard in Switzerland, and in the iſland of Jura, one of the Hebrides*.

* Mineralogy of the Scottiſh iſles.

TWENTY-

TWENTY-FIFTH SPECIES.

Hornblende.

Hornblende.—*Werner.*

This ſpecies is divided by Werner into four ſub-ſpecies, *viz.* 1. Common hornblende. 2. Labrador hornblende. 3. Baſaltic hornblende. 4. Hornblende ſlate.

FIRST SUBSPECIES.

Common Hornblende.

Gemeiner Hornblende.—*Werner*.

Hornblende, *Kirw*. vol. 1. p. 213.—Gemeiner hornblende, *Estner*, b. 2. f. 699.—*Id. Emm*. b. 1. p. 322. and b. 3. f. 267.—Orniblenda commune, *Nap*. p. 276.—La hornblende commune, *Broch*. t. 1. p. 415.

External Characters.

It is commonly greenifh black, or raven black, which in fome varieties approaches to greyifh and velvet black; in others to dark greenifh grey. Sometimes the blackifh green verges on leek green.

Occurs maffive, diffeminated, and fometimes in long and broad prifmatic cryftals, which are imbedded, interfect one another, and are fometimes fcopiformly aggregated: on this account it is difficult to determine their figure. Werner fuppofes that they are oblique four-fided prifms.

Internally its luftre is generally fhining, fometimes paffing to fplendent, and nearly pearly.

Fracture commonly foliated, ſometimes alſo ſmall and broad radiated; the foliated is almoſt always ſtraight foliated, and the radiated is generally promiſcuouſly and ſcopiformly diverging.

The fracture ſurface is longitudinally ſtreaked. The foliated has a double obliquely interſecting cleavage.

Fragments are uſually indeterminately angular, blunt edged, but the large foliated approach to rhomboidal.

Occurs in large, coarſe, ſmall, and fine grained diſtinct concretions.

The black varieties opaque, the green generally tranſlucent on the edges.

Gives a mountain green, falling into greeniſh grey ſtreak.

Semi-hard, paſſing to ſoft.

Difficultly frangible.

Not particularly heavy, approaching to heavy.

Specific gravity——3,600 to 3,830, *Kirwan.*

When moiſtened it exhales a bitter ſmell.

Chemical Characters.

It melts eaſily without addition before the blow pipe into a greyiſh black glaſs.

Constitnent

Constituent Parts.

Silica	37,0	48,83	37,0
Alumina	22,0		27,0
Magnefia	16,0	17,50	3,0
Lime	2,0	16,66	5,0
Oxyd of iron	23,0	17,50	25,0
Lofs			3,0
	100	1,49	100
	Kirwan. Min. vol. 1. p. 213.	*Wiegleb.* Chemifche Annalen, 1787.	*Hermann.* Berl. Beobacht, 79.

Geognostic Situation.

It forms one of the effential ingredients of feveral mountain rocks; is fometimes accidentally differninated in others; and occurs in beds. Thus it forms one of the principal ingredients of fyenite and primitive greenftone, alfo of tranfition and floetz greenftone: and it occurs accidentally in granite, gneifs, mica flate, and limeftone; and when in beds, it is fometimes accompanied with ores, as magnetic iron ftone, iron pyrites, &c.

Geographic Situation.

It is found very widely extended, as in Norway, Sweden, England, Scotland, Saxony, Bohemia, Silesia, Hungary, Alps, Siberia, &c.

Use.

When it is free of admixture with quartz and felspar, it forms an excellent flux for iron ores.

SECOND SUBSPECIES.

Labrador Hornblende.

Labradorifche Hornblende.—*Werner*.

External Characters.

It is ufually brownifh black, greenifh black, copper red*, and feldom greyifh black.

Occurs maffive, differminated, and in rolled pieces.

Internally its luftre is from ftrongly glimmering to fhining, and is femi-metallic.

Fracture nearly the fame with hornblende, only it is ufually curved foliated†.

Fragments indeterminately angular, yet fometimes approach to rhomboidal.

* The copper red colour, which is characteriftic of this fpecies, is fufpected by Werner to be accidental, and probably produced in the fame manner as that of the Labrador ftone.

† Hauy, in a Memoir on labrador hornblende, publifhed in the 7th number of the Annales du mufeum national, afferts, tha the cleavage is not only rectangular, but that that it is obliquely interfected by another.

Occurs

Occurs in large, coarſe, ſmall, and ſometimes thin lamellar diſtinct concretions.

Opaque.

Semi-hard.

Pretty eaſily frangible.

Specific gravity—3,3857.

Geographic Situation.

Is found in the iſland of St Paul, on the coaſt of Labrador.

THIRD

THIRD SUBSPECIES.

Hornblende Slate.

Hornblende ſchiefer.—*Werner.*

Schiſtoſe hornblende, *Kirw.* v. 1. p. 222.—La hornblende ſchiſteuſe, *Broch.* t. i. p. 428.

External Characters.

Its colour is intermediate between greeniſh and raven black.

It is maſſive.

Internally its luſtre is ſhining and gliſtening, approaching to pearly.

Fracture in the great ſlaty, in the ſmall promiſcuous radiated.

Fragments ſometimes tabular, and ſometimes indeterminately angular.

Gives a greeniſh grey ſtreak.

Semi-hard, paſſing into ſoft.

Not particularly frangible.

In other characters it agrees with the foregoing.

It

It is not always pure, but is frequently mixed with felſpar and mica.

Geognostic Situation.

It occurs in more or leſs mighty beds in primitive rocks, particularly in clay ſlate; alſo in gneiſs and mica ſlate.

Geographic Situation.

It is found in Norway, Sweden, Scotland*, at Portſoy, &c.; Saxony, at Hartmanſdorf, Chemnitz, &c.

* Mineralogy of the Scottiſh iſles.

FOURTH

FOURTH SUBSPECIES.

Bafaltic hornblende.

Bafaltifche hornblende.—*Werner.*

Bafaltifche hornblende, *Wid.* p. 417.——Bafaltine, *Kirw.* vol. 2. p. 219.—Bafaltifche hornblende, *Eftner*, b. 2. f. 719.—*Id Emm.* b. 1. f. 330. and b. 3 f. 269 —Orniblenda bafaltica, *Nap.* p. 281.—Amphibole, *Lam.* t 2. p. 330.—Amphibole cryftallifée, *Hauy*, t, 3. p. 58.—La hornblende bafaltique, *Broch*, t. 1. p 424.

External Characters.

Its colour is velvet black.

Occurs almoft always in fingle imbedded cryftals, and thefe are

1. Equilateral fix-fided prifms flatly acuminated on both extremities by three planes, which are fet contrary-wife on the alternate lateral edges.
2. A fimilar prifm, flatly acuminated on one extremity by four planes, which are fet on the four oppofite lateral planes, on the

other bevilled, the bevilling planes ſet on the two oppoſite lateral edges.

3. Similar priſm at one extremity flatly acuminated by three planes, which are ſet on the alternate lateral edges, on the other bevilled, the bevilling planes ſet on the oppoſite lateral edges.

Cryſtals ſmall and middle ſized.

Surface ſmooth.

Luſtre of the principal fracture ſplendent, croſs fracture gliſtening and vitreous.

Principal fracture perfectly ſtraight foliated, with a double obliquely interſecting cleavage; croſs fracture fine grained uneven approaching to ſmall conchoidal.

Fragments generally indeterminately angular, ſometimes alſo rhomboidal.

Always opaque.

Semi-hard.

Pretty brittle.

Eaſily frangible.

Not particularly heavy.

Specific gravity.—3,250, *Hauy*.—From 3,150 to 3,220, *Reuſs*.—3,333, *Kirwan*.

Chemical Character.

Before the blow pipe it melts into a black glaſs, but is more refractory than common hornblende.

Constituent

Constituent Parts.

Silica	58,0
Alumina	27,0
Iron	9,0
Lime	4,0
Magnefia	1,0
	99,0

According to *Bergman*, Opufc. t. 3, p. 207.

Geognostic Situation.

It is found commonly imbedded in bafalt and wacce, and alfo wrapped in lava.

Geographic Situation.

It is found in Saxony, Bohemia, Scotland, Italy, &c.

Obfervations.

1. It refifts decompofition longer than bafalt, hence we frequently find good cryftals difperfed in the

 clay

clay which is formed by the decompoſition of baſaltic rocks.

2. It is remarkable that common hornblende is difficultly frangible, and this ſpecies eaſily frangible.

3. It is often confounded with augite, from which, however, it differs in many characters. Augite has always a green colour, which is not the caſe with baſaltic hornblende, it is harder, has rather an indiſtinct cleavage, gives no ſtreak, has a reſinous luſtre, and its cryſtallization is different.

TWENTY-SIXTH SPECIES.

Bafalt.

Bafalt.—*Werner.*

Id. Wid. p. 423.—Figurate trap, *Kirw.* vol. 1. p. 231.—Bafalt, *Eftner*, b. 2. f. 726, *Id. Emm.* b. 1. f. 339.—Bafalto, *Nap.* p. 284.—Le bafalte, *Broch.* t. 1. p. 430.—*Hauy*, t. 4. p. 474.

External Characters.

Its moft common colour is greyifh black, of various degrees of intenfity; from this it paffes into afh grey, which inclines to brown, and even in fome varieties approaches to raven black.

Occurs maffive, in blunt and rolled pieces, and fometimes veficular.

Internally it is generally dull, feldom feebly glimmering, owing to an admixture of foreign particles.

Fracture moft commonly coarfe grained uneven, fometimes alfo imperfectly large conchoidal and fine fplintery,

ſplintery, and ſome rare varieties verge on even and earthy.

Fragments indeterminately angular, not very ſharp edged.

Occurs almoſt always in diſtinct concretions. Theſe are generally columnar, and from a few inches to ſeveral fathoms, even to upwards of a 100 feet in length; are ſometimes ſtraight, ſometimes bent, and either parallel or diverging. In mountains theſe concretions are collected into larger groupes, and many of theſe groupes or concretions together form a hill or mountain. Sometimes the columns are articulated, and the joints have concave and convex faces.

Beſides columnar it occurs alſo in large globular diſtinct concretions, which are again compoſed of concentric lamellar concretions.

Some varieties are compoſed of large, coarſe, and fine grained diſtinct concretions.

Sometimes alſo tabular.

Generally opaque, and ſometimes tranſlucent on the edges.

Gives a light aſh grey ſtreak.

Semi-hard, bordering on hard.

Brittle.

Very difficultly frangible.

Intermediate between not particularly heavy and heavy.

Specific gravity.—3,000, *Bergman.*—2,864, *Briſſon.*—2,979, *Kirwan.*

Chemical

Chemical Characters.

Before the blow pipe it melts eafily without addition into an opaque black glafs. According to Dr Kennedy, the bafalt of the caftle rock of Edinburgh foftens at 45° of Wedgewood ; that of Staffa at 38°*, and I obtained fimilar refults with the bafalt of Arran, as is mentioned in my account of that ifland.

Constituent Parts.

Silica	50,0	44,50	48,0
Alumina	15,0	16,75	16,0
Oxyd of Iron	25,0	20,0	16,0
Lime	8,0	9,50	9,0
Magnefia	2,0		
Oxyd of Manganefe		0,12	
Moifture and vol. matter			5,0
Soda		2,60	4,0
Water		2,00	1,0
		99,72	99,0
According to *Bergman*.		Bafalt of the Haffenberg. according to *Klaproth*.	Bafalt of Staffa, according to *Kennedy*†.

* Edinburgh Tranfactions for 1799.

† We have now to deplore the death of this very able analyft, whofe fkill in conducting, and ingenuity in devifing experiments was only rivalled by the excellence of a Kirwan, a Hatchett, and a Klaproth.

Geognostic

Geognostic Situation.

According to the obfervations of Werner, it is exclufively confined to the floetz trap formation. Charpentier, however, in his work entitled Beobachtungen über die lagerftätte der Erze, &c. informs us that he found bafalt in mica flate near Grobfdorf in Silefia, and in gneifs in the Fichtelgebirge; but thefe beds, on a more attentive examination, have been found to be very compact dark coloured greenftone.

Occurs in ftrata, beds, and veins, of which we have numerous examples in Scotland, as we find mentioned in an excellent but little known work, The Mineral Kingdom, by Williams; in Profeffor Playfair's illuftrations of the Huttonian Theory; Faujas de St Fond's travels, and in my outline of the Mineralogy of the Scottifh ifles.

Geographic Situation.

It occurs in almoft every quarter of the globe. In Europe, it has been obferved in Iceland, Faroe iflands, Sweden, (of which the famous Kennekula and Hünneberg are in part compofed); Scotland, in vaft abundance; Ireland, particularly in the northern provinces; England; Saxony, where it occurs particularly beautiful at Stolpen, and inftructive at Scheibenberg,

berg, where Werner made the important obſervations that gave us the firſt true idea of its mode of formation ; Sileſia, of which the remarkable depoſition in the Schneegruben highly elevated on the Rieſen gebürge, has excited ſo much inquiry, and which require the acuteneſs of a Werner to elucidate and explain. Bohemia, where the remarkable hill called Camerbühl, compoſed of veſicular baſalt long paſſed for volcanic; Franconia, Swabia, Hungary ; many places on the banks of the Rhine ; Auvergne in France, where varieties of veſicular baſalt have been miſtaken for lava, even by the acute Dolomieu, and by Von Buch, a pupil of Werner. Lugano, in Italian Switzerland, Euganean mountains ; Catanea ; Monte Servato, near Barcelona ; and in the neighbourhood of Liſbon.

In Aſia it has been obſerved by Neibuhr, at Hadie Andjor in Yemen ; Kuſma ; and Beit-El-Taki ; and by Patrin on the banks of the Amoar in Dauria.

Of Africa I can give no localities, nor of America. In Auſtralaſia, it has been hitherto found only in New Holland.

In Polyneſia it has been obſerved, and in Otaheite, Eaſter iſland, Owai in the Sandwich iſlands, and in Kergeulens iſland.

Uſe.

It is employed as a building ſtone, touch ſtone, as a flux for certain ores of iron, in glaſs manufac-

 tures,

tures, in the making of common green glafs. The veficular varieties are employed for mill-ftones. Although it is harder, more brittle, and lefs obedient to the chefil, and its colours not fo pleafing or durable as marble, yet the ancients, who were acquainted with its greater indeftructibility, executed many fine works in it. Pliny has defcribed feveral fine pieces of fculpture faid to have been done in this ftone; and the famous ftatue of Minerva ftill to be feen at Thebes, is by travellers defcribed as bafalt. Many of the antique bafalts, which are preferved in collections, are evidently fyenite or greenftone.

Obfervations.

1. Imbedded in it we find bafaltic hornblende, olivine, fometimes (when it borders on wacce) mica, alfo calc fpar, felfpar, calcedony, and zeolite.

2. The cavities which it fometimes contains have been found filled with water: inftances of this kind, obferved in Germany, are mentioned by Stucke, and Dr. Richardfon of Belfaft has obferved fimilar appearances in the bafalt of the Giants Caufeway.

3. The theory of its formation was long a fubject of difpute among mineralogifls, but it is now univerfally admitted to be an aquatic production. An account of its geognoftic characters and natural hiftory will be given in the Geognofie.

3. In

3. In Scotland it is denominated whin ſtone, yet this name is not confined to baſalt; under it is alſo included nearly all the other rocks of the trap, ſyenite, and porphyry formations; and in many places granite, grey wacce, and primitive and tranſition clay ſlate have the ſame appellation. We ſhould therefore agree to baniſh this vague and unmeaning term from mineralogy.

TWENTY SEVENTH SPECIES.

Wacce.

Wakke.—*Werner.*

Wacken, *Kirw.* vol. 1. p. 223. *Wacke.—Efmer.* b. 2. f. 737. id.—*Emm.* b. 1. f. 335. id.—*Nap.* f. 228. *La Wakke.—Broch.* t. 4. p. 434.

External Characters.

Its colour is greenifh grey of various degrees of intenfity: from light greenifh grey, it paffes into afh grey, and verges on yellowifh grey. When it paffes to bafalt, it is greyifh black. When it is brownifh it is owing to its impregnation with iron ochre.

It occurs fometimes maffive, fometimes alfo veficular, and the veficulæ are either filled, when the compound is denominated amygdaloid, or empty.

Is dull, fometimes feebly glimmering.

Fracture in general even, fometimes it runs into imperfectly large and flat conchoidal, fometimes into uneven, even into earthy.

Fragments

Fragments indeterminately, angular rather blunt edged.

Always unſeparated.

Opaque.

Streak more or leſs ſhining.

Mild.

Uſually ſoft; ſome varieties approach to ſemi hard.

More or leſs eaſily frangible.

Not particularly heavy.

It is characteriſtic of it that it falls in the open air.

Chemical Characters.

Is ſaid to be equally fuſible with baſalt: it was very carefully analyſed by Dr Mitchell; unfortuately I have not been able to avail myſelf of the reſult of his reſearches, as he has left no account of his experiments.

Geognostic Situation.

According to Werner, it belongs excluſively to the floetz trap formation, where it occurs in beds which generally lie under baſalt, and above clay *. It

* Some German mineralogiſts mention wacce, as belonging to the primitive rocks, and have inſtanced ſeveral places in Sileſia where

It is found alſo in veins, and generally forms the baſis of amygdaloid.

It frequently contains imbedded cryſtals of mica and baſaltic hornblende, but does not, like baſalt, include augite or olivine.

Geographic Situation.

In Saxony, it is found at Scheibenberg, Annaberg, Wieſenthal, Joachimſthal, and Schlackenwalde; in Bohemia, at Bilin; and at Kinnekulle, and Norberg in Weſtmannland in Sweden.

Obſervations.

1. It is conſidered by Werner as intermediate between baſalt and clay. When baſalt contains mica, it is paſſing to wacce, becauſe mica is nearly characteriſtic of wacce.

2. Near Joachimſthal, there is an immenſe rent filled with wacce, in which whole trees are found imbedded.

3. Many of the foſſils deſcribed by Karſten, Charpentier, Reuſs, Ferber, and other mineralogiſts,

where ſuch appearances are to be obſerved. I enjoyed the invaluable opportunity of examining theſe places along with Dr Mitchell, but we found in every inſtance that diſintegrated greenſtone had been confounded with wacce.

are

are the true wacce of Werner, others, however, are moſt evidently greenſtone. Full illuſtrations on this ſubject will be given in the Geognoſie.

4 The gray wacce of Werner which is an aggregate rock, compoſed of fragments of flinty ſlate, clay ſlate, and quartz, connected by a baſis of clay ſlate, muſt not be confounded with this ſpecies.

TWENTY

TWENTY-EIGHTH SPECIES.

Clinkſtone.

Klingſtein.—*Werner.*

Porphirſchiefer, *Eſtner*, b. 2. ſ. 747.—Klingſtein, *Emm.* b. 3. ſ. 344.—Pierre ſonante, *Broch.* t. 1. p. 437. Klingſtein, *Klap. Beit.* b. 3. ſ. 229

External Characters.

It is commonly dark greeniſh gray, which ſometimes paſſes into yellowiſh and aſh gray.

Always maſſive.

Croſs fracture feebly glimmering, almoſt dull; the principal fracture ſtrongly glimmering, paſſing into gliſtening.

Croſs fracture, ſplintery, paſſing into conchoidal, and even; principal fracture, is more or leſs perfectly ſlaty.

Fragments indeterminately angular, moſtly ſharp edged: ſometimes they are tabular.

In

In the great it occurs in irregular columnar and tabular diſtinct concretions.

Commonly tranſlucent on the edges.

Hard and ſemi-hard.

Brittle.

Eaſily frangible.

Not particularly heavy.

Specific gravity.—2,575.—*Klaproth.*

When ſtruck with a hammer, ſounds like a piece of metal.

Chemical Character.

Melts eaſily, and gives a nearly colourleſs glaſs, whereas baſalt gives a black glaſs.

Conſtituent Parts.

Silica	57,25
Alumina	23,50
Oxyd of iron	2,25
Manganeſe	0,25
Natron	8,10
Water	3,00
	98,10

According to *Klaproth.*

Geognostic Situation.

According to Werner, it belongs to the floetz trap formation. It generally refts on bafalt, which was to be expected from its more chemical nature. It has a great affinity to bafalt, into which indeed it fometimes paffes.

Geographic Situation.

It is found near Zittau in upper Lufatia; in the Bohemian Mittelgebirge, and many other places of that highly interefting country; in South America according to Humbold, and in the inland of Lamlafh in the frith of Clyde, where it occurs in beautiful and large columnar diftinct concretions.

Obfervations.

1. Very generally cryftals of felfpar are imbedded in it, and then it forms porphyry flate, a rock which is very different from porphyry, although it has been often confounded with it.

2. Dr Reufs, in his mineralogical defcription of Bohemia, mentions it as belonging to the primitive rocks; this affertion, however, is devoid of proof.

TWENTY-NINTH SPECIES.

Lava.

Lava.—*Werner.*

This ſpecies is by Werner divided into two ſub-ſpecies. 1. Slag Lava. 2. Foam Lava.

FIRST SUBSPECIES.

Slag Lava.

Schlackige Lava.—*Werner.*

External Characters.

Its colour is greyiſh black, which paſſes into yellowiſh grey, greeniſh grey, and ſometimes into greeniſh black.

It is externally ſpotted, reddiſh, yellowiſh brown, and grey; when the ſulphureous vapour has acted

much on it, it is coloured yellowiſh white and ſulphur yellow.

It occurs veſicular and knotty, and the veſicles are empty. Internally its luſtre alternates from glimmering to gliſtening, and ſometimes alſo ſhining.

Its fracture is imperfectly conchoidal, alſo fine grained uneven.

Is generally opaque, ſometimes a little tranſlucent on the edges.

Is ſemi-hard,

Brittle.

Eaſily frangible.

Not particularly heavy.

Obſervation.

It frequently incloſes other foſſils, as augite, hornblende, and leuzite, which, being more refractory, have eſcaped nearly unaltered.

SECOND

SECOND SUBSPECIES.

Foam Lava.

Schaumige Lava.—*Werner*.

External Characters.

Its colour is dark greenifh grey, which approaches to greenifh black.

It occurs fometimes fmall and fine veficular, and alfo amorphous.

Externally its luftre is glimmering.

It is difficult to determine its fracture; Werner fufpects that it is uneven.

Is flightly tranflucent on the edges.

It is intermediate between hard and femi-hard.

Brittle.

Eafily frangible, often completely crumbling.

Light.

Obfervation.

Obſervations.

1. It has been very often confounded with pumice, from which it differs very much, as may be ſeen by comparing the deſcriptions given in this work.

2. Its particular geognoſtic characters will be given at full length in the Geognóſie; at preſent I ſhall only mention one character, firſt obſerved by Werner, which ſufficiently diſtinguiſhes it from unaltered rocks. When lava contains cryſtals of hornblende, augite, or leuzite, they are wrapped up, not imbedded in its baſis; and, when they occur in veſicles or air holes, one part of the cryſtal projects into the cavity, and the other is included in the lava, and does not therefore, as is the caſe with zeolite or other foſſils formed by infiltration, &c. fill the air holes, form druſes, or only cover the ſides.

3. It is the opinion of many mineralogiſts that lava ſhould not find a place in a ſyſtem of Oryctognoſie, but for what reaſon I have never been able to learn. Werner conſiders it as entitled to its preſent place, becauſe it is mechanically ſimple.

Uſe.

On account of its lightneſs it is employed for building, particularly for arching vaults. The rock out of which the famous millſtones of Andernach are

cut

cut does not belong to this ſpecies, although it has been aſſerted by ſeveral mineralogiſts, but to the floetz trap rocks.

Obſervation.

Hauy, in his Treatiſe on Mineralogy, enumerates the following ſpecies of lava: 1. Baſaltic lava. 2. Petroſiliceous lava. 3. Felſpathic lava. 4. Amphigenous lava. 5. Vitreous lava, comprehending obſidian, pearlſtone, and pumice. 6. Scoriaceous lava. Of all theſe the only true lava is the laſt mentioned; the others, as will be ſhewn in the Geognoſie, are natural unaltered rocks.

THIRTIETH SPECIES.

Green Earth *.

Grünerde.—*Werner.*

Green earth, *Kirw.* vol. 1. p. 196. *Emm.* t. 1. p. 353.—La terre verte, *Broch.* t. 1. p. 445.

External Characters.

Its colour is feladon green of various degrees of intenfity, which paffes into mountain and blackifh green, feldom approaches to leek and olive green.

It occurs fometimes maffive, fometimes in angular, alfo in globular and amygdaloidal fhaped pieces, alfo diffeminated, or as a cruft lining the veficles or air holes of amygdaloid, or covering agate balls.

Internally it is dull.

Fracture even, fometimes fine earthy, fometimes paffing into flat conchoidal.

Fragments indeterminately angular blunt-edged.

Streak gliftening.

* This and the following fpecies connect the Clay and Talc Genera together.

Very

Very ſoft.
Mild.
Eaſily frangible.
Light.

Geognostic Situation.

It is found principally in amygdaloid, in which it occurs in balls, cruſts, and amygdaloidal ſhaped pieces. Dr Reuſs, in the third volume of his Mineralogy of Bohemia, deſcribes beds of it, that appear to belong to the floetz trap formation.

Geographic Situation.

It is found in Saxony, Bohemia, Monte Baldo near Verona, Scotland, and wherever amygdaloid occurs.

Uſe.

It is uſed by painters.

THIRTY-FIRST SPECIES.

Lithomarge.

Steinmark.—*Werner.*

Id. Wid. p. 434.—Lithomarga, *Kirw.* vol. 1. p. 187.—Litomarga, *Nap.* p. 259.—Steinmark, *Emm.* t. 1. p. 355.—La Moelle de Pierre ou la Lithomarge, *Broch.* t. 1. p. 447.

Werner divides this ſpecies into two ſubſpecies. 1. Friable Lithomarge. 2. Indurated Lithomarge.

FIRST SUBSPECIES.

Friable Lithomarge, or Rockmarrow.

Zerreibliches Steinmark.—*Werner.*

External Characters.

Its colours are ſnow white, yellowiſh white, and ſeldom reddiſh white.

Is uſually maſſive, occurs alſo as a cruſt, and diſſeminated.

Its luſtre is feebly glimmering.

Is generally coherent, alſo ſometimes looſe, and is compoſed of fine ſcaly particles that approach to duſty.

Feels greaſy.

Adheres to the tongue.

Geognostic Situation.

Found in conſiderable quantity in the Saxon tin veins.

SECOND SUBSPECIES.

Indurated Lithomarge, or Rockmarrow.

Feftes Steinmark.—*Werner.*

External Characters.

It is moft commonly white, of which it prefents the following varieties: yellowifh, fnow, and reddifh white; alfo pearl grey, plumb blue, lavender blue; further, flefh red and ochre yellow.

The white and red are uniform, but the other colours are ufually difpofed in clouded and fpotted delineations *.

Is maffive.

Internally it is dull.

Fracture large conchoidal, paffing into even and fine earthy.

* The Wonder earth, or terra miraculofa, which is a variety of this fubfpecies, is remarkable for the beauty of its colour delineations.

Streak

Fragments indeterminately angular, not particularly ſharp edged.

Streak ſhining.

Very ſoft.

Perfectly mild.

Eaſily frangible.

Adheres ſtrongly to the tongue.

Feels greaſy.

Is light.

Geognostic Situation.

It occurs in veins of porphyry, gneiſs, and ſerpentine; in druſy cavaties in topaz rock, or nidular in baſalt, amygdaloid, and ſerpentine; and in beds over coal.

Geographic Situation.

Found in Saxony at Ehrenfriederſdorf, Altenberg, Marienberg, Rochlitz, where the fleſh red variety occurs in porphyry, Planitz *, where it lies over coal; in Bohemia, Bavaria, and the Harz.

* The variety called Wonder earth is found at Planitz.

Obſervation.

Obſervation.

It paſſes on the one ſide into ſteatite, and probably alſo meerſchaum, and on the other into variegated clay.

THIRTY-SECOND SPECIES.

Rock Soap.

Bergseife.—*Werner*.

Id. Cronst. p. 189. *Id. Wid.* p. 436. *Emm.* t. 1. p. 360.—Le savon de montagne, *Broch.* t. 1. p. 453.

External Characters.

Its colour is pitch or brownish black.
Is massive and disseminated.
Dull.
Fracture fine earthy.
Fragments indeterminately angular, blunt edged.
Opaque.
Does not soil.
Writes as well, if not better, than drawing slate.
Streak shining and resinous.
Very soft.
Completely mild.

Eaſily frangible.

Adheres ſtrongly to the tongue.

Is not particularly heavy, nearly light.

It has much reſemblance to indurated lithomarge.

Geognostic and Geographic Situations.

Found imbedded in rocks belonging to the floetz trap formation. It is very rare, and has been hitherto found only at Olkutſch in Poland, and in the Iſland of Skye in Scotland.

Uſe.

If it could be procured in quantity it would form a moſt excellent material for the painter.

THIRTY-THIRD SPECIES.

Yellow Earth.

Gelberde.—*Werner*.

Id. Wid. p. 427.—Yellow earth, *Kirw.* vol. 1. p. 194. *Emm.* t. 1. p. 362.—La terre jaune, t. p. 455.

External Character.

Its colour is ochre yellow of various degrees of intenfity.

Is maffive.

The luftre of its principal fracture is feebly glimmering, crofs fracture dull.

Principal fracture more or lefs perfectly flaty, crofs fracture earthy.

Fragments partly indeterminately angular, blunt edged, partly tabular.

Streak fomewhat fhining.

It foils.

Writes.

Is very foft, paffing into friable.

Adheres pretty ſtrongly to the tongue.
Feels a little greaſy.
Light.

Geognostic and Geographic Situations.

It occurs in beds, along with iron ſtone, in the flötz clay formation, at Wehraw in Upper Saxony.

Uſe.

It is employed as a yellow pigment.

FIFTH GENUS.

TALC GENUS.

FIRST SPECIES.

Bole.

Bohl.—*Werner.*

Bole, *Kirw.* p. 191. *Id. Eſtner,* b. 2. f. 784. *Id. Emm.* b. 1. f. 381.—Bolo, *Nap.* p. 256.—Le Bol, *Broch.* t. 1. p. 459.

External Characters.

Its colour is cream yellow, which, by reaſon of the red in its compoſition, paſſes on the one ſide into fleſh red, on the other into light yellowiſh brown, and then into a colour which is intermediate between cheſnut brown and browniſh black. Sometimes it is ſpotted brown and black.

It

It is commonly maſſive, ſeldom diſſeminated.

Internally its luſtre is glimmering.

Fracture perfectly conchoidal.

Fragments indeterminately angular ſharp edged.

The red variety is ſemi-tranſparent, the yellow tranſlucent on the edges, the dark opaque.

Very ſoft.

Mild.

Eaſily frangible.

Feels greaſy.

Gives a ſhining ſtreak.

Adheres to the tongue.

Light.

Specific gravity,—1,400 to 2,000, *Kirwan.*

When dry and put into water, it breaks with an audible crackling noiſe.

Chemical Characters.

Before the blow pipe it melts without addition into a greeniſh grey coloured clay, according to Wiedenmann.

Constituent

Constituent Parts.

Magnefia	6,2
Silica	47,0
Alumina	21,0
Lime	5,4
Iron	5,4
Water	17,0
	102

Bergman Opufcal Chem. t. 4. p. 152.

Geognostic Situation.

It occurs in rocks belonging to the neweft floetz trap formation.

Geographic Situation.

It is found in beds of wacce at Strigau in Silefia, and in bafalt at Scheibenberg in Saxony; in Italy it is found at Sienna and Tofcana, and in the Ifland of Lemnos in the Hellefpontic Archipelago.

Ufe.

Uſe.

It was formerly uſed as a medicine, now it is only employed as a pigment.

Obſervation.

It is diſtinguiſhed from Lithomarge by colour, luſtre, tranſparency, and falling to pieces in water,

SECOND SPECIES.

Native Talc Earth.

Helvin oder Natürliche Talkerde.—*Werner.*

Magnefie Native, *Broch.* t. 2. p. 499—.

External Characters.

Its colour is yellowifh grey, paffing into cream yellow. It is marked with blackifh brown coloured fpots, and with fimilar coloured dendritic delineations.

Occurs maffive, tuberofe, and of fhape which is intermediate between veficular and perforated; and the walls of the cells are rough and uneven.

Internally it is dull.

Fracture in the great pretty large and flat conchoidal, in the fmall, fplintery.

Fragments more or lefs fharp edged.

Almoft opaque.

Soft, paffing to very foft.

Not very mild.

Not

Not particularly difficultly frangible.
Feels a little meagre.
Adheres a little to the tongue.
Not particularly heavy, approaching to light.

Constituent Parts.

According to the analyſis of Dr Mitchell and Profeſſor Lampadius it affords carbonic acid 0,510, magneſia 0,474, and a trace of iron, *Lampad. Samml. Practiſch. Chem. abhandl.* b. 3.

Geognostic Situation.

It is found in ſerpentine rocks accompanied with meerſchaum.

Geographic Situation.

Has been hitherto found only at Robſchütz in Moravia.

Obſervations.

1. Werner, from its external characters, places it between bole and meerſchaum.

2. We are indebted to Dr Mitchell for our knowledge of this foſſil. He found it during his travels in

in Auſtria, and on his return to Freyberg preſented it to Werner, who drew up the preceding deſcription, and gave it its preſent place in the ſyſtem.

THIRD SPECIES.

Meerſchaum.

Meerſchaum.—*Werner.*

Id. Wid. ſ. 456.—Keffekil, *Kirw.* vol 1. p. 144.—Meerſchaum, *Emm.* b. 1. ſ. 378.—Schiuma di mare, *Nap.* p. 307.—Varieté de talc, *Lam.* p. 342.—L'ecume de mer, *Broch,* t. 1. p. 462.

External Characters.

Its colour is yellowiſh white, which approaches to yellowiſh grey; it is very rarely ſnow white.

Occurs maſſive.

Internally it is dull.

Fracture fine earthy, paſſing into flat conchoidal; or is ſometimes large conchoidal in the great, and fine earthy in the ſmall.

Fragments indeterminately angular, pretty ſharp edged.

Opaque.

Streak ſhining.

Soft, paſſing into very ſoft.

Mild.

Not particularly eaſily frangible.

Adheres ſtrongly to the tongue.

Feels a little greaſy.

Light, and nearly ſwimming.

Specific gravity—1,600, according to *Klaproth.*

Chemical Characters.

Before the blow pipe it is infuſible without addition.

Constituent Parts.

Silica	54,16	From 58,50	to 41,00
Magneſia	51,66	17,25	18,25
Lime		0,50	0,50
Water		2,50	39,00
Carbonic acid		5,00	
	105,82	98,25	98,75
	Wieglib.	*Klaproth.* b. 2. ſ. 172.	

Geognostic

Geognoſtic Situation.

It is ſaid to occur in ſome places in beds.

Geographic Situation.

It is principally found in Natolia, in Leſſer Aſia; and the iſland of Samos; alſo in Greece, Hungary, Robſchütz in Moravia; at Valecas near Madrid in Spain; in ſmall quantities in Thuringia; and in ſome parts of the continent of America.

Uſe.

It is principally uſed for the manufacture of the heads of tobacco pipes, and the quantity employed for that purpoſe is very great. It is ſaid that the Turks eat it, when ſpread on bread, as a medicine, and cover the head and eyes of dead bodies with it, before burial. As it abſorbs oily matter it is uſed by the Tartars for cleanſing.

Obſervations.

1. It is ſufficiently diſtinguiſhed from native talc earth by its colours, greater ſoftneſs, and leſs ſpecific

gravity; from lithomarga, by its not poſſeſſing the ſame ſuite of colours, and its leſs ſpecific gravity; from bole, by its colours, want of luſtre, and tranſparency.

2. It is ſaid to be very ſoft in its repoſitory, but when expoſed to the air becomes harder.

3. It is named Meerſchaum, from its great lightneſs, and its being ſometimes found in the neighbourhood of the ſea.

4. The Tartarian name Keffikil which Mr Kirwan aſſumes as the name of this ſpecies, is ſaid to have been impoſed on it by the Turks, becauſe the Tartars name it Kila.

5. The ſubſtance of which the Indian tobacco-pipes are made is not known to mineralogiſts.

6. Strabo and Pliny mention floating bricks, and lately Mr Fabroni has been able to form ſimilar ones, from a foſſil ſubſtance, which is found near Caſtel del Piano near Sienna. Mr Brochant ſuſpects that it may be meerſchaum.

FOURTH SPECIES.

Fullers Earth.

Walkererde.—*Werner*.

Id. Wid. p. 429.—Fuller's earth, *Kirw.* vol. 1. p. 184.—Walkerde, *Eſtner*, b. 2. ſ. 777. *Id. Emm.* b. 1. ſ. 375.—Terra da follone, *Nap.* p. 258.—La Terra a Foulon, *Broch.* t. 1. p. 464.

External Characters.

Its colours are greeniſh white, greeniſh grey, olive and oil green.

Some varieties exhibit ſpotted and ſtriped colour delineations.

Maſſive.

Internally it is dull.

Fracture ſometimes uneven, ſometimes paſſing into large conchoidal, ſeldom ſplintery; in ſome varieties fine earthy, and ſometimes ſhews a tendency to fine ſlaty.

Fragments indeterminately angular, blunt edged; alſo ſlaty.

Uſually opaque.

Gives a ſhining ſtreak.

Very ſoft, paſſing into friable.

Mild.

Adheres ſcarce perceptibly to the tongue.

Feels greaſy.

Not particularly heavy.

Sometimes it is coloured and mixed with iron ochre, but this is to be conſidered as accidental.

Chemical Character.

It melts into a brown ſpungy ſcoria; it falls to pieces in water without forming a paſte with it, or without foaming like ſoap, as is aſſerted by ſome authors.

Constituent Parts.

Hampſhire fullers earth affords

Silica	51,8
Alumina	25,0
Lime	3,3
Magneſia	0,7
Iron	0,7
Water	15,5

Bergman. Opuſcul. t. 4. p. 156.

Geognoſtic

Geognostic Situation.

At Roſſwein in Upper Saxony, it is found under ſtrata of greenſtone ſlate, conſequently it there belongs to the primitive rocks. In England, where the fineſt fullers earth is found, it is ſtill problematical whether it occurs in alluvial land, or in one of the newer flötz formations, or in both.

Geographic Situation.

Found in Hampſhire and Bedfordſhire in England; at Rofswein andin Voightl and in Saxony; at Rittenau in Alſace; and Oſmundburg in Sweden.

Uſe.

It is uſed for cleanſing woollen cloth, which is effected by an operation called fulling, whence the name fullers earth.

Obſervations.

Werner ſuſpects that the fullers earth of Roſſwein in Saxony is formed by the decompoſition of greenſtone ſlate, as it is there covered by it, and we can trace the gradation from fully-formed fullers earth to freſh

fresh greenstone. May it not in this case rather be considered as an original deposition of greenstone in a loose state of aggregation, resembling the disintegrated felspar in certain beds of gneiss, &c.?

FIFTH SPECIES.

Nephrite.

Nephrit.—*Werner.*

This species is by Werner divided into two subspecies. 1. Common Nephrite. 2. Axe stone.

FIRST SUBSPECIES.

Common Nephrite.

Gemeiner Nephrite.—*Werner*.

External Characters.

Its colour is leek green, of various degrees of intenſity, and ſometimes paſſes into greeniſh white.

Occurs maſſive, in blunt edged pieces, and rolled pieces.

Generally dull; ſometimes it exhibits a ſilver white glimmer, which is cauſed by intermixed fibres of talc and aſbeſt

Fracture coarſe ſplintery, and the ſplinters greeniſh white.

Fragments indeterminately angular, not remarkably ſharp edged.

Tranſlucent.

Hard.

Difficultly frangible.

Feels a little greaſy.

A little brittle.

Not remarkably heavy.

Constituent Parts.

What is called the nephrite of Switzerland, according to Hoepnfer affords,

Silica	47,0
Magnefia	38,0
Alumina	4,0
Lime	2,0
Oxyd of Iron	9,0

Geognostic Situation

Is not known; probably occurs in ferpentine.

Geographic Situation.

It is found on the banks of the river of Amazons, in South America; in China and the Eaft Indies; and it is faid to have been found in feveral parts of Europe, as in the dutchy of Auftria, Moravia, Tyrol, Switzerland and Savoy.

Ufe.

It is difficult to faw and cut, and although it takes a good polifh it has ftill an oily and muddy afpect. Its great tenacity, however, enables the artift to execute

cute on it beautifully delicate figures, without the riſk of breaking. The Turks cut it into handles for ſabres and daggers, which they prize very much; and the Indians make taliſmans of it.

Obſervations.

1. It was long believed to be a remedy for alleviating, or even curing and preventing nephritic complaints, hence it was called Nephritic ſtone.

2. In India it is named Igida, from whence the Abbé Eſtner conjectures is derived the French word Jade.

SECOND SUBSPECIES.

Axeſtone.

Beilſtein —*Werner.*

Id. Eſtner, b. 2. ſ. 851. *Id. Emm.* b. 3. ſ. 351. — La Pierre de Hache, *Broch.* t. 1. p. 470.

External Characters.

Its colour is intermediate between mountain green and leek green, and paſſes into dark graſs green, oil green and greeniſh grey.

Occurs maſſive.

Internally its luſtre is ſtrongly glimmering.

Fracture ſlaty in the great, and more or leſs diſtinctly ſplintery in the ſmall.

Fragments tabular.

Tranſlucent.

Semi-hard, approaching to hard.

Not particularly brittle.

Difficultly frangible.

Not particularly heavy.

Geognostic

Geognostic Situation.

Occurs in beds in the newer primitive mountains, particularly in clay ſlate?

Geographic Situation.

Auſtralaſia, in New Zealand; ſeveral of the iſlands of Polyneſia; Europe, in Saxony, Carpathian Alps, Switzerland, Corſica; Aſia, in China.

Uſe.

It is uſed by the natives of New Zealand, and ſeveral of the iſlands of Polyneſia, for hatchets and other offenſive weapons.

Obſervations.

It approaches to indurated talc, particularly the Saxon varieties.

SIXTH SPECIES.

Steatite.

Speckſtein.—*Werner.*

Creta hiſpanica, *Wall.* t. 1. p. 396.—Creta brianſonia. *Wall.* t. 1. p. 390—Spectſtein, *Wid.* ſ. 451.—Semindurated Steatite, *Kirw.* vol. 1. p. 151.—Spectſtein, *Eſtner.* b 2. ſ. 791.—*Id. Emm.* b. ſ. 363.—Steatite compatta, *Nap.* p. 296.—Steatite, *Lam.* t. 2. p. 343.—La Steatite commune, *Broch.* t. 1. p. 474.

External Characters.

Its principal colour is white, of which it preſents the following varieties: greyiſh, greeniſh, ſeldom yellowiſh, and reddiſh white: the reddiſh borders on fleſh red: the greeniſh white paſſes into mountain, oil, and laſtly into ſiſkin green.

Sometimes it ſhews dendritic and ſpotted delineations.

It occurs maſſive, diſſeminated, in cruſts, and cryſtalliſed.

The cryſtals are ſix-ſided priſms, acuminated on both extremities by ſix planes, that are ſet on the lateral planes. The cryſtals are very rare.

The

The lateral planes are tranfverfly ftreaked, but the acuminating planes are fmooth.

They are middle fized, fmall, and are imbedded in the maffive.

Internally it is dull, or accidently glimmering.

Fracture coarfe fplintery, in many varieties uneven, in others conchoidal, and in fome rare varieties we obferve a tendency to coarfe fibrous.

Fragments undeterminately angular, blunt edged.

Commonly tranflucent on the edges, feldom faintly tranflucent.

Streak fhining.

Very foft and foft.

Perfectly mild.

Rather difficultly frangible.

Does not adhere to the tongue.

Feels greafy.

Is not particularly heavy.

Specific gravity.—Steatite of Bareuth, 2,614. according to Blumenbach.

Chemical Characters.

Before the blow pipe, it lofes its colour, and becomes hard, but is infufible without addition.

Constituent

Constituent Parts.

	Steatite of Cornwall.	Of Bareuth.	
Silica	48,0	59,50	58,33
Magnesia	20,50	30,50	39,16
Oxyd of iron	1,0	2,50	2,50
Water	15,50	5,50	0,0
Alumina	14,0	0,	0,
	99,0	98,0	99,99
	Klap. t. 2. p. 177.	t. 2. p. 180.	*Weigleb.*

Geognostic Situation.

It occurs in beds and veins in serpentine; also in irregular shaped pieces, imbedded in rocks, (particularly wacce,) belonging to the floetz trap formation.

Geographic Situation.

It is found in Norway, Sweden, Saxony, Bohemia, Principality of Bareuth, France, England, particularly at Cape Lizard, Scotland, at Portsoy, where it traverses serpentine in form of veins, and in the island of Skye, where it is imbedded in wacce. Is also found in China.

Use

Use.

The cornifh is ufed for the manufacture of porcelaine; other varieties are faid to be ufed for fulling, and the Chinefe work it into veffels of various fhapes.

Obfervations.

The yellowifh white variety, approaches to lithomarge, the flefh red to bole, and the fifkin green and greenifh grey, to fullers earth.

SEVENTH SPECIES.

Serpentine.

Serpentin.—*Werner.*

This fpecies is by Werner divided into two fubfpecies, 1. Common ferpentine, 2. Precious ferpentine.

FIRST SUSBPECIES.

Common Serpentine.

Gemeiner Serpentin.—*Werner.*

Id. Eſtner. b. 2. ſ. 855.—Talcum ſerpentinus vulgaris, *Id. Emm.* b. 3. ſ. 276.—La ſerpentine commune, *Broch.* t. 1. p. 481.

External Characters.

Its principal colour is green, of which it preſents the following varieties ; leek, oil, and olive green ; from oil green it paſſes into mountain green and greeniſh grey ; from leek green it paſſes into greeniſh black ; from greeniſh black, it paſſes into blackiſh green : ſometimes it occurs yellow, and rarely yellowiſh brown ; further red, of which it preſents the following varieties : blood red, browniſh red, peach bloſſom red, and ſcarlet red.

The peach bloſſom, and ſcarlet red colours are the rareſt.

The colour is ſeldom uniform, there are generally ſeveral colours together, and theſe are arranged in ſtriped, dotted, and clouded delineations.

It occurs maſſive.

Internally it is faintly glimmering, which paſſes into

to dull, when there are no foreign particles to give a ſlight degree of luſtre.

Fracture is ſometimes ſplintery, ſometimes large and flat conchoidal, alſo ſmall grained, uneven, paſſing into even.

Fragments are indeterminately angular, not particularly ſharp edged.

Faintly tranſlucent on the edges.

Soft.

Not particularly brittle, paſſing into mild.

Not very difficultly frangible.

Feels a little greaſy.

Not particularly heavy.

Chemical Character.

Before the blow pipe, it is infuſible without addition.

Constituent Parts.

Magneſia	23,0	33,50	35,0
Silica	45,0	45,00	41,0
Alumina	18,0		10,0
Iron	3,0		3,0
Iron and a trace of al.		14,00	
Lime		6,25	
Water	12,0		
	Kirwan.	*Knoch.* Chem. Ann. 1790. 2. ſ. 504.	*Bayer.*

Geognostic

Geognostic Situation.

It is one of the primitive rocks. Werner defcribes two formations, one, which is the oldeft, occurs in the oldeft clay flate, and is accompanied with lime-ftone; the other, which is confiderably newer, is fuppofed to be difpofed in overlaying ftratification over the older primitive rocks. The oldeft generally contains the precious ferpentine; thus intimating a more complete folution than that of the newer formation. The newer is not accompanied with lime-ftone, but contains imbedded pyrope, magnetic iron ftone, fteatite, and affords the common ferpentine.

Geographic Situation.

It is found in Saxony, as at Zöblitz, (this is the newer formation,) Waldheim, Hohenftein, Limbach, Chemnitz; in Bohemia, Silefia, Corfica, Italy, Siberia, England, as in Cornwall; (probably the newer formation;) Scotland, at Portfoy, (the older formation,) and in the Shetland iflands, (probably the newer formation).

Ufe.

As it is foft and takes a good polifh, it is turned into veffels and ornaments of a great variety of fhapes.

At

At Zöblitz in Upper Saxony, ſeveral hundred people are employed in quarrying, cutting, turning, and poliſhing the ſerpentine, which occurs in that neighbourhood, and the various articles into which it is manufactured are carried all over Germany, The ſerpentine of Portſoy is far ſuperior to that of Zöblitz in colour, hardneſs, and tranſparency, and when cut is very beautiful.

SECOND

SECOND SUBSPECIES.

Precious Serpentine.

Edler Serpentin.—*Werner.*

Eſtner. b. 2. ſ. 859.—*Id. Emm.* t. 3. ſ. 276.—La ſerpentine noble, *Broch.* t. 1. p. 484.

This ſubſpecies is by Werner divided into two kinds: *a.* Conchoidal precious ſerpentine; *b.* Splintery precious ſerpentine.

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a. Conchoidal precious ſerpentine.

External Characters.

Its colour is dark leek green, paſſing into blackiſh green; and it ſometimes, although ſeldom, approaches to piſtacio green.

Occurs maſſive, and diſſeminated.

Internally its luſtre is gliſtening, ſometimes paſſing into glimmering, and is reſinous.

Fracture conchoidal.

Fragements

Fragments indeterminately angular, very ſharp edged.

Tranſlucent.

Not particularly brittle.

Feels rather greaſy.

Not particularly heavy.

Soft, and ſemi-hard.

Geographic Situation.

It is found in Sileſia.

Obſervation.

The verde antico is a variety belonging to this kind.

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b. Splintery Precious Serpentine.

External Characters.

Its colour is nearly the ſame with the preceeding.

Maſſive.

Fracture ſplintery.

Fragments indeterminately angular, but not ſo

Geographic

ſharp edged as thoſe of the conchoidal kind; in other characters it agrees with the preceeding.

Geographic Situation.

It is brought from Italy, where it is named Nephrite. It is alſo found, but ſparingly, in Saxony; alſo at Reichenſtein in Sileſia, where it is accompanied with amianth, granular lime-ſtone, or goldiſh pyrites.

EIGHTH SPECIES.

Schiller Stone.

Schillerſtein.—*Werner.*

External Characters.

Its colour is olive green.

Uſually diſſeminated and maſſive, probably alſo cryſtallized.

Luſtre ſhining, paſſing into ſemi-metalic.

Fracture perfectly foliated, ſingle cleavage.

Sometimes

Sometimes unſeparated, ſometimes in large and coarſe grained diſtinct concretions.

Soft.

Slightly brittle.

Eaſily frangible.

Not particularly heavy.

Geognostic Situation.

It occurs imbedded in ſerpentine, and is frequently accompanied with mica.

Werner is of opinion that it bears the ſame relation to ſerpentine, that calc-ſpar does to lime-ſtone, or ſelenite to foliated gypſum, and may, therefore, perhaps, be conſidered as cryſtallized ſerpentine..

Geographic Situation.

It is found at Baſta in the Harz, at Zöblitz in Saxony; Mr Hatchett diſcovered it in Cornwall, and I have it from Ayrſhire.

Obſervation.

It has been, and by many mineralogiſts is ſtill confounded with labrador hornblende, from which, as

we have already learnt, it differs both in geognoſtic and oryctognoſtic characters.

NINTH SPECIES.

Talc.

Talk.

This ſpecies is by Werner divided into three ſub-ſpecies: 1. Earthy talc: 2 Common talc: 3 Indurated talc.

FIRST SUBSPECIES.

Earthy Talc.

Erdiger Talc.—*Werner.*

Id. Wid. f. 439.—Talcite, *Kirw.* p. 1. 149.—Erdiger talc, *Eſtner*, b. 2. f. 821.—*Emm.* b. 1. f 389 —Talco terrofo, *Nap.* p. 295.—Le talc terreux, *Broch.* t. p. 486.

External Characters.

Its colour is intermediate between greeniſh white and light greeniſh grey.

Friable.

Strongly glimmering, bordering on gliſtening.

It is compoſed of glimmering pearly ſmall ſcaly parts.

Soils a little.

Feels rather greaſy.

Light.

Geognoſtic Situation.

Occurs in tin veins.

Geographic

Geographic Situation.

Found near Freyberg in Saxony.

Obſervation.

It muſt not be confounded with Schaum or foaming earth.

SECOND SUBSPECIES.

Common or Venetian Talc.

Gemeiner Talc.—*Werner.*

Gemeiner talc, *Wid.* p. 441..—Common talc, or Venetian talc, *Kirw.* vol. 1. p. 150.—Gemeiner talc, *Eſlner,* b. 2. ſ. 824.—*Id. Emm.* b. 1. ſ. 391.—Talco compatto, *Nap.* p. 293.—Talc ecailleux.—*Lam.* t. 2. p. 342.—Talc laminaire.—*Hauy* Le talc commun, *Broch.* t. 1. p. 487.

External Characters.

Its principal colour is apple green, which paſſes on one ſide into greeniſh white, and even into ſilver white, on the other into aſparagus green, and rarely into emerald green?

Is maſſive, and diſſeminated, and in extremely delicate and ſmall tabular cryſtals, which are ſometimes collected in druſes.

It is almoſt always ſplendent and ſhining, and internally it is pearly or ſemi-metallic; (the white varieties poſſeſs the ſemi-metallic luſtre).

Fracture ſtraight, and curved foliated, often alſo undulatingly foliated, as is the caſe with mica.

Fragments

Fragments wedge ſhaped, ſeldom ſplintery.

Cleavage ſingle.

Tranſlucent, but tranſparent in thin leaves.

It occurs in large, coarſe, ſmall, and fine grained diſtinct concretions, but more frequently unſeparated.

Flexible, but not elaſtic.

Very ſoft.

Perfectly mild.

Eaſily frangible.

Feels very greaſy.

Is not particularly heavy, approaching to light.

Chemical Character.

It is infuſible before the blow pipe without addition, a character which diſtinguiſhes it from chlorite. *Brochant.*

Constituent Parts

Magneſia	44,00
Silex	50,00
Alumina	6,00

According to *Hæpfner*, Helv. Mag. iv. s. 296.

It

Geognostic Situation.

It is almoſt entirely confined to the primitive mountains, where it occurs in beds, imbedded in ſerpentine, and alſo in veins.

Geographic Situation.

Very beautiful ſpecimens are found in the Tyrolefe Alps, and the mountains of Switzerland and Salzburgh; alſo in Saxony, at Ehrenfriederſdorf, and Zöblitz.

Obſervation.

It is frequently confounded with mica, from which, however, it is diſtinguiſhed by want of elaſticity, greaſy feel, and colour.

THIRD SUBSPECIES.

Indurated Talc.

Verhærteter Talk.—*Werner.*

Id. Eſtner, b. 2. ſ. 828. *Id. Emm.* b. 3. ſ. 280.—Le talc endurci, *Broch.* t. 1. p. 489.

External Characters.

Its colour is greeniſh grey, of various degrees of intenſity.

Occurs maſſive.

Luſtre ſhining paſſing to gliſtening, and is pearly.

Fracture intermediate between imperfectly foliated and curved ſlaty; ſome varieties even paſs into promiſcuouſly fibrous and rayed.

Fragments ſlaty.

Strongly tranſlucent on the edges, ſometimes paſſing into tranſlucent.

Soft, approaching to very ſoft.

Perfectly mild.

Not particularly difficultly frangible.

Feels rather greaſy.

Not particularly heavy.

Conſtituent Parts.

Magneſia	38,54
Silica	38,12
Alumina	6,66
Lime	0,41
Iron	15,02

Wiegleb. Hæpfn. Helv. Magazin. iii. ſ. 166.

Geognostic Situation.

It occurs in primitive mountains, where it forms beds in clay ſlate, and ſerpentine, and is accompanied with chlorite and aſbeſt.

Geographic Situation.

It is found in the Tyrol, Auſtria, Stiria, Switzerland; Scotland, in Breadalbane, and the Shetland iſlands.

Obſervations.

It has a very ſtrong reſemblance to potſtone, with which it has been often confounded.

TENTH SPECIES.

Aſbeſt.

Aſbeſt.—*Werner.*

Werner divides this ſpecies into the following ſub-ſpecies, 1. Rock cork. 2. Amianth. 3. Common aſbeſt. 4. Rock wood.

FIRST SUBSPECIES.

Rock Cork.

Berg Kork,—*Werner.*

Aluta montana, *Wall.* t. 1. p. 414.—Suber montanum, *Id.* p. 415. — Bergkork, *Wid.* f. 469.—Suber montanum, corium montanum, *Kirw.* vol. 1. p. 163.—Bergkork *Eſtner*, b. 2. f. 864. *Id. Emm.* b. 1. f. 399. — Sughero montano, *Nap.* p. 319. — Varieté d'amianthe, *Lam.* p. 367. – La fiege de montagne, *Broch.* t. 1. p. 492.

External Characters.

Its moſt common colour is yellowiſh grey, of various degrees of intenſity, which paſſes into yellowiſh white, greyiſh white, and pale aſh grey; it is alſo ſometimes yellowiſh brown, and cream yellow.

Seldom preſents ochre yellow ſpots.

Occurs ſometimes maſſive, ſometimes in plates and with impreſſions*.

Luſtre feebly glimmering, ſometimes nearly dull.

* The plate-ſhaped variety is named rock leather, and rock fleſh.

Obſervation.

On one ſide it (by reaſon of its fibrous fracture), borders on amianth, on the other on meerſchaum.

SECOND SUBSPECIES.

Amianth.

Amianth.—*Werner.*

Aſbeſtus maturus. *Wall.* t. 1. p. 410.—Amianthus, *Id.* p. 408.—Amianth, *Wid.* ſ. 464. *Id. Kirw.* vol. 1. p. 161. *Eſtner.* b. 2. ſ. 368. *Id. Emm.* b. 1. ſ. 402.—Amiantho, *Nap.* p. 316.—*Lam.* t. 2. p. 365.—L'amianthe *Broch.* t. 1. p. 494.

External Characters.

Its moſt common colour is greeniſh white, of different degrees of intenſity, paſſing into greeniſh grey and light olive green; ſometimes blood red, particularly when it occurs venigenous in ſerpentine.

Generally

Generally maſſive, alſo in plates and ſmall veins that traverſe ſerpentine, and in capillary cryſtals.

Internally its luſtre is gliſtening paſſing to ſhining; alſo ſometimes ſplendent and pearly, approaching to ſilky.

Fracture very delicately parallelly fibrous, and ſometimes a little curved.

Fragments thin ſplintery.

Sometimes faintly tranſlucent, ſometimes only tranſlucent on the edges.

Very ſoft.

Mild.

Intermediate between common and elaſtically flexible.

Splits eaſily.

Difficultly frangible.

Light, approaching to not particularly heavy.

Chemical Characters.

It is difficultly fuſible before the blow pipe.

Constituent

Constituent Parts.

	A. of Swarlich.	A. of Tarentaife.	A. of Corias in Spain.
Silica	64,0	64,0	7,20
Magnefia	17,2	18,6	12,9
Alumina	2,7	3,3	13,3
Lime	13,9	6,9	10,5
Barytes		6,0	
Iron	2,2	1,2	2,2
	100	100	99,19

According to *Bergman.*

It has been lately analyfed by Chenevix, who obtained the following refult.

Silica	59,0
Magnefia	25,0
Lime	9,$\frac{1}{4}$
Alumina	3,0
Iron	2,$\frac{1}{4}$
Lofs	1,$\frac{1}{4}$
	100

Patrin's Mineralogie, and Nouveau Dictionnaire D'Hiftoire Naturelle, t. 1. p. 309.

Geognoftic

Geognostic Situation.

It is found in primitive rocks, and particularly in ſerpentine in which it occurs uſually in veins.

Geographic Situations.

It is found in Sweden, Bohemia, Sileſia, Italy, Hungary, Siberia, France, Spain, and Scotland, as at Inveraray, Portſoy, and iſle of Unſt one of the Shetlands *.

Uſes.

From its flexibility, and its reſiſting the effects of fire, it is ſaid to have been, by the ancients, wove into a kind of cloth, in which they wrapped the bodies of perſons of diſtinction before they were placed on the funeral pile, that their aſhes might be collected free from admixture; it was alſo uſed for incombuſtible wicks, but it is now conſidered only as an object of curioſity.

* Mineralogy of the Scottiſh iſles.

THIRD SUBSPECIES.

Common Afbeft.

Gemeiner Afbeft.—*Werner*.

Afbeftus immaturus, *Wall*. t. 1. p. 411.—Gemeiner afbeft, *Wid*. p. 471.—Afbeftus, *Kirw*. vol. 1. p. 159.—Gemeiner afbeft, *Eftner*, b. 2. f. 872. *Id. Emm*. b. 1. f. 406. —Afbefto commune, *Nap* p. 314.—Afbefte, *Lam*. t. 2. p. 369—Afbefte dur, *Hauy*.—L'Afbefte commune, *Broch*. t. 1. p. 497.

External Characters.

Its colours are dark leek green, and mountain green, fometimes alfo greenifh grey, and greenifh grey paffing into olive green.

It occurs maffive and in capillary cryftals.

Internally its luftre is gliftening and pearly.

Fracture parallely radiated, and coarfely, parallely, and curved fibrous *.

* Patrin, in his Natural Hiftory of Minerals, defcribes and figures a foffil by the name Abefte Rayonnant, which, however, is only a variety of actynolite. The fibrous diverging fracture fhews that it does not belong to abeft.

Fragments

Fragments ſplintery.

Commonly tranſlucent, at leaſt on the edges.

Soft, verging on ſemi hard.

Not particularly brittle.

Rather difficultly frangible.

Not flexible; ſome varieties ſhew an incipient flexibility.

Feels rather greaſy.

Not particularly heavy.

Chemical Characters.

Before the blow pipe it melts very difficultly into a greyiſh black coloured ſcoria.

Conſtituent Parts.

Silica	46,66
Magneſia	48,45
Iron	4,79

Wiegleb Chem. Ann. 1784, b. 1. ſ. 521.

Geognoſtic Situation.

Is the ſame as amianth.

Geographic Situation.

Is found in Sweden, Hungary, Dauphiny, Uralian Mountains, and Scotland.

Obſervations.

1. It ſtands in the ſame relation to amianth, as indurated does to common talc.

2. Some varieties approach to indurated talc, others to amianth.

FOURTH SUBSPECIES.

Rock Wood.

Bergholz.—*Werner.*

Id. Wid. ſ. 473.—Ligniform aſbeſtus, *Kirw.* vol. 1. p. 161. —Bergholz, *Eſtner*, b. 2. ſ. 877. *Id. Emm.* b. 1. ſ. 410. Legno montano, *Nap.* p. 321.—Aſbeſte ligniforme, *Hauy*, t. 3. p. 240.—Le bois de montagne, *Broch.* t. 1. p. 499.

External Characters.

Its colour is wood brown of various degrees of intenſity.

Occurs maſſive, and in plates.

Internally its luſtre is glimmering.

Fracture in the great curved foliated, in the ſmall delicately and promiſcuous fibrous.

Fragments ſlaty.

Streak more ſhining than its luſtre.

Soft, paſſing into very ſoft.

Mild.

Rather difficultly frangible.

A little elaſtically flexible.

Feels meagre.

Light.

Geognostic

Geognostic and Geographic Situations.

It occurs principally in the Tyrol, where it is found in primitive mountains along with amianth.

General Obſervations on the Species.

The different ſubſpecies of this ſpecies generally occur in the ſame geognoſtic ſituations, only the rock cork is found in mineral veins. They are uſually found in ſerpentine.

ELEVENTH SPECIES.

Kyanite, or Cyanite.

Cyanit, oder Kyanit.—*Werner.*

Sappare, Sauff. f. 1900. & *J. de Phy.* 1789, p. 213.—Cyanite, *Wid.* f. 475. *Id. Kirw.* vol. 1. p. 209. *Id. Eſtner*, b. 2. f. 690. *Emm.* b. 1. p. 412. *Id. Nap.* p. 328.—Cyanite, *Lam.* t. 2. p. 256.—Difthene, *Hauy*, t. 3. p. 220.—La Cyanite, *Broch.* t. 1. p. 501.

External Characters.

Its principal colour is blue, and of this the following varieties occur: ſmalt blue, berlin blue, ſky blue, and this latter borders on ſeladon green. It occurs alſo milk white, blueiſh grey, and pearl grey.

Many ſpecimens are entirely blue, others are only ſpotted, ſtriped, or flamed with it.

It occurs maſſive, diſſeminated, and cryſtaliſed in long and broad, a little oblique, four-ſided priſms, which are truncated on the lateral edges.

They are either imbedded or interſect one another, and are middle ſized, ſmall, and very ſmall.

Externally

Externally and internally its luſtre is ſhining and ſplendent, and is completely pearly.

Its fracture is very broad, diverging, promiſcuous, a little curved radiated, and ſometimes paſſes into curved foliated.

The fracture of the cryſtals is foliated, and preſents a three fold cleavage, in which the folia interſect each other obliquely, and under unequal angles; but of theſe only one cleavage is diſtinct.

Fragments ſlaty, ſplintery, wedge-ſhaped, and ſometimes imperfectly rhomboidal.

It occurs in wedge-ſhaped diſtinct concretions, which are often very promiſcuous, and then paſs into large and coarſe grained diſtinct concretions.

Uſually tranſlucent, and the cryſtals often tranſparent.

Soft.

Not particularly brittle, approaching to mild.

Has a ſlight degree of flexibility.

Eaſily frangible.

Feels a little greaſy?

Not particularly heavy, approaching to heavy.

Specific gravity.—3,517, *Sauſſure the younger*.—3,622, *Hermann*.

Chemical Character.

Before the blow pipe it is infuſible without addition.

Constituent

Conſtituent Parts.

Silica	29,2	to 30,62
Alumina	55,0	54,5
Lime	2,25	2,02
Magneſia	2,0	2,3
Oxyd of iron	6,65	6,0
Water and loſs	4,9	4,56
	100,0	100,0

According to *Sauſſure the younger.*

Geognostic Situation.

It is peculiar to the primitive mountains, where it occurs imbedded in talc ſlate, and mica ſlate, accompanied with grenatite.

Geographic Situation.

It is found in Norway; in Scotland, in Aberdeenſhire near Banchory, and in the Mainland, the largeſt of the Shetland iſlands *; France, Bavaria, Alps of Switzerland, particularly in Mount St. Gothard, Salzburg, the Tyrol, Carinthia, Pyrenees, and in Siberia.

* Mineralogy of the Scottiſh iſles.

3 N *Obſervations.*

Obſervations.

1. It is the link which connects talc with actynolite and tremolite.

2. The blue colour does not occur in any other talcy foſſil; it is therefore characteriſtic of kyanite.

3. It was at firſt arranged in the flint genus, along with the ſpecies ſchorl; as ſoon, however, as Werner had an opportunity of examining it, he found that it was eſſentially different from ſchorl, and conſtituted a diſtinct ſpecies, which by its natural characters proved to be a ſpecies of the talc genus.

4. Its name is derived from the blue colour which ſo remarkably characteriſes it.

5. Varieties which have a fine berlin blue colour and conſiderable tranſparency, are cut and ſold as ſapphire.

6. The very pale varieties are ſold for tremolite, but the ſlight tinge of blue which always accompanies the paleſt, is a mark which diſtinguiſhes it from tremolite. In doubtful caſes the geognoſtic character is of aſſiſtance: tremolite occurs uſually in limeſtone, but kyanite in talc or mica ſlate.

TWELFTH

TWELFTH SPECIES.

Actynolite.

Strahlstein.—*Werner*.

This species is by Werner divided into three sub-species.

FIRST SUBSPECIES.

Aſbeſtous Actynolite.

Aſbeſtartiger Strahlſtein.—*Werner.*

Id. Wid. ſ. 479.—Amianthinite, and Metalliform Aſbeſtoid, *Kirw.* vol. 1. p. 164. & 167.—Aſbeſtartiger Strahlſtein, *Emm.* b. 1. ſ. 416.—Aſbeſtoide, *Lam.* t. 2. p. 371.—Actinote, *Hauy.*—La Rayonnante Aſbeſtiforme, *Broch.* t. 1. p. 504.

External Characters.

Its colour is greeniſh grey, which paſſes on the one ſide through mountain green into ſmalt blue, on the other through olive green into yellowiſh and liver brown. In ſome varieties it approaches to black. The blue variety is very rare.

It occurs maſſive, diſſeminated, and in capillary cryſtals.

The cryſtals are ſometimes elaſtically flexible.

Internally its luſtre is gliſtening and pearly or rather ſilky.

Its fracture is intermediate between fibrous and narrow radiated; the latter is longitudinally ſtreaked, alſo ſtraight, ſcopiform, and ſtellular.

Fragments

Fragments wedge ſhaped.

It occurs in coarſe and wedge ſhaped priſmatic diſtinct concretions.

It is from tranſlucent on the edges to opaque.

Soft and very ſoft.

Brittle.

Rather difficultly frangible.

Not particularly heavy.

Specific gravity—2,584, *Raſchau.*—2,916, *Bareuth.*

Chemical Characters.

Before the blow pipe it is fuſible without addition into a black or grey coloured ſcoria.

Geographic and Geognoetic Situations.

It occurs in mineral beds at Raſchau near Schwartzenberg in Saxony, Bareuth, and Bannat of Temeſwar. That of Bareuth is ſaid to occur in ſerpentine.

SECOND

SECOND SUBSPECIES.

Common Actynolite.

Gemeiner Strahlſtein.—*Werner.*

Id. Wid. ſ. 480.—Schorlaceous actynolite, and commo aſbeſtoid, *Kirw.* vol. 1. p. 168. and 166.—Gemeiner ſtrahlſtein, *Eſtner.* b. 2. ſ. 887.—*Id. Emm*, b. 1. ſ. 418. —Stralite commune, *Nap.* p. 323.—Zillerthite, *Lam.* t. 2. p. 357. —Actinote hexaedre, *Hauy*, t. 3. p. 74.— La Rayonnante commune, *Broch.* t. 1. p. p. 507.

External Characters.

Its principal colour is leek green, from which it paſſes on the one ſide through piſtacio green *, olive green, into liver brown ? on the other into mountain green ? and blackiſh green.

It occurs maſſive and cryſtalliſed, in very oblique rhomboidal ſix ſided priſms, in which the two oppoſite lateral edges are obtuſe, and the terminal angles truncated ; or we may conſider it as a very

* The piſtacio green variety is almoſt always cryſtalliſed, and Werner ſuſpects that it may prove a diſtinct ſpecies. It is the Thallite of the French Mineralogiſts.

oblique

oblique rhomboidal four-fided prifm, having its acute lateral edges truncated.

The cryftals are long, often acicular, and imbedded. The lateral planes are fmooth, and often longitudinally ftreaked.

Externally it is fplendent, internally fhining, and intermediate between vitreous and pearly.

Fracture moft commonly radiated, from very fmall to pretty broad radiated, almoft always fcopiformly, and diverging radiated, feldom parallel; fometimes it is foliated, with an indiftinct two fold cleavage.

Fragments fometimes wedge fhaped and fplintery, fometimes indeterminately angular, blunt edged.

It occurs in wedge-fhaped prifmatic concretions, alfo in large, coarfe, and fmall grained diftinct concretions.

The maffive is intermediate between tranflucent, and tranflucent on the edges, and fometimes even verges on tranfparent. Cryftals tranfparent.

Semi-hard in a high degree.

Pretty brittle.

Pretty difficultly frangible.

Not particularly heavy, approaching to heavy.

Specific gravity, from 3,000, to 3,310. *Kirwan.*

Chemical Characters.

It is fufible without addition, into a blackifh fcoria according to Wiedenman, but according to Lelievre into a grayifh black enamel.

Conftituent

Constituent Parts.

Silica	64,0
Magnefia	20,0
Alumina	2,7
Lime	9,3
Iron	4,0
	100,0

Bergman Opufc. t. 4. p. 172.

Geognostic Situation.

The maffive variety occurs in beds, in primitive mountains, accompanied with different fpecies of ore, as lead glance, magnetic iron ftone, and iron pyrites. The cryftallifed varieties are found in granular limeftone, talc flate, and in veins of the oldeft formation.

Geographic Situation.

Saxony, as at Ehrenfriederfdorf, Giefhübel, Tyrol, Salzburg, Switzerland, Piemont, Norway, and Scotland, as in Glenelg, oppofite the ifland of Skye, and Fula, the moft remote of the Scottifh ifles *.

* Mineralogy of the Scottifh ifles.

Obfervation.

Obſervation.

The green ſchorl of Romé d'Liſle, the delphinite of Sauſſure, the thallite of La Metherie, the epidote of Hauy, appear to be only varieties of this ſub-ſpecies.

THIRD SUBSPECIES.

Glaſſy Actynolite.

Glaſartiger Strahlſtein.—*Werner.*

Id. Wid. ſ. 483.—Glaſſy actynolite, *Kirw.* vol. 1. p. 168.—Glaſartiger ſtrahlſtein, *Eſtner*, b. 2. ſ. 893.—*Id. Emm.* b. 1. ſ. 422.—Stralite vetroſa, *Nap.* p. 326.—La Rayonnante vitreuſe, *Broch.* t. p. 510.

External Characters.

Its principal colour is mountain green of various degrees of intenſity, which paſſes on the one ſide into greeniſh grey and greeniſh white, on the other into emerald green, and dark graſs green ?

Occurs maſſive, or in thin ſix ſided acicular cryſtals.

Luſtre ſhining, and vitreous.

Fracture delicately and coarſely promiſcuous fibrous, and narrow, ſcopiformly diverging radiated, ſeldom parallelly radiated.

Fragments

Fragments ſplintery and wedge ſhaped.

Thick priſmatic diſtinct concretions, incloſe ſmaller ones of the ſame kind.

Strongly tranſlucent.

Brittle.

Eaſily frangible.

Has croſs rents.

Semi-hard, approaching to ſoft.

Not particularly heavy.

Specific gravity according to *Kirwan*, is from 2,950, to 3,903.

Its geognoſtic and geographic ſituations are nearly the ſame as the preceeding ſubſpecies.

Obſervation.

The foſſils of this ſpecies appear to paſs into hornblende, aſbeſt, and tremolite. Thus aſbeſtous actynolite ſeems to paſs into amianth, the blackiſh green variety of common actynolite appears to be intermediate between actynolite and hornblende, as is ſhown by its colours, luſtre and hardneſs; and the greeniſh white variety of glaſſy actynolite, verges on glaſſy tremolite.

THIRTEENTH

THIRTEENTH SPECIES.

Tremolite.

Tremolith.—*Werner.*

Werner divides this ſpecies into three ſubſpecies, 1. Aſbeſtous Tremolite. 2. Common Tremolite. 3. Glaſſy Tremolite.

FIRST SUBSPECIES.

Aſbeſtous Tremolite.

Aſbeſtartiger Tremolith.—*Werner.*

Id. Emm. b. 1. ſ. 425. *Id. Eſtner*, b. 2. ſ. 893.—La Tremolith aſbeſtiforme, *Broch.* t. 1. p. 514.

External Characters.

Its colours are yellowiſh white, alſo greyiſh white, reddiſh white, and greeniſh white.

Internall y

Occurs maſſive, and in capillary and acicular cryſtals.

Internally its luſtre is gliſtening, ſometimes bordering on glimmering, ſometimes paſſing to ſhining, and is pearly.

Fracture moſt generally delicately, ſtraight, and ſcopiformly diverging fibrous.

Fragments ſplintery and wedge ſhaped.

Occurs in diſtinct concretions, which are wedge-ſhaped priſmatic, paſſing into granular, and are promiſcuous.

Only tranſlucent on the edges, but approaches to tranſlucent, when it borders on the following ſub-ſpecies.

Very ſoft.

Eaſily frangible.

Mild.

Not particularly heavy.

SECOND SUBSPECIES.

Common Tremolite.

Gemeiner Tremolith.—*Werner.*

Id. Eſtner, b. 2. ſ. 901. *Id. Emm.* h. 1. ſ. 426.—Grammatite, *Hauy?*—La tremolithe commune, *Broch.* t. 1. p. 515.

External Characters.

Its colours are greyiſh, greeniſh, yellowiſh and reddiſh white. The greeniſh white paſſes into pale aſparagus green; and the greyiſh white into dark ſmoke grey. It probably alſo occurs bluiſh grey? when verging on kyanite.

Occurs ſometimes maſſive, ſometimes in long and very oblique four-ſided priſms, in which the obtuſe lateral edges are ſometimes rounded off, ſo that the cryſtal has a reed-like aſpect; ſometimes they are bevilled, and the bevilling planes are ſet on the acute lateral edges; and ſometimes the lateral edges are truncated.

The cryſtals are middle ſized, longitudinally ſtreaked, promiſcuouſly aggregated, and are imbedded.

Occurs

Internally its luftre is fhining and gliftening, and is pearly.

Fracture fometimes broad radiated, fometimes foliated; both are ftreaked, and the foliated appears to have a two fold longitudinally interfecting cleavage, whence the fracture has a longitudinally ftreaked furface. The radiated is promifcuous and fcopiformly radiated.

Crofs fracture uneven.

Fragments indeterminately angular, and approach fometimes to the cubical.

The maffive occurs in large and coarfe grained diftinct concretions, which fometimes approach to the wedge-fhaped prifmatic.

Tranflucent, but the cryftallized femi-tranfparent.

Semi-hard.

Pretty eafily frangible.

Not particularly heavy.

THIRD SUBSPECIES.

Glaſſy Tremolite.

Glaſartiger Tremolith.—*Werner.*

Id. Fſtner, b. 2. ſ. 907. *Id. Emm.* b. 1. ſ. 429.—La Tremolithe vitreuſe, *Broch*, t. 1. p. 516.

External Characters.

Its colours are yellowiſh, reddiſh, greyiſh and greeniſh white.

Occurs maſſive and cryſtallized.

Internally its luſtre is ſhining, paſſing to gliſtening, and is pearly.

Fracture very narrow radiated, which ſometimes inclines to ſcopiformly diverging, and ſometimes approaches to fibrous.

It has parallel oblique croſs rents, reſembling ſchorlous beryll.

Fragments moſt uſually ſplintery.

It is compoſed of very thin priſmatic concretions, which are again collected into very thick priſmatic concretions. The latter are rather wedge-ſhaped, and are promiſcuous.

Tranſlucent.

Soft

Very eaſily frangible.
Brittle.
Not particularly heavy.

Chemical Characters.

Before the blow pipe it melts without addition into a cellular white coloured ſcoria.

Constituent Parts.

Silica	65,00
Magneſia	10,33
Lime	18,00
Oxyd of iron	0,16
Water and carbonic acid	6,50
	99,99

Klaproth.

Phyſical Character.

Said to emit a phoſphoric light when rubbed in the dark, which property is denied by Count de Bournon.

Geognostic Situation.

It is found principally in primitive mountains, and is there usually imbedded in limestone. It has been also found in rocks belonging to the floetz trap formation, accompanied with prehnite.

Geographic Situation.

It has been hitherto found in the greatest beauty and quantity in the mountains of Tremola, in the vicinity of St Gothard in Switzerland; also in Transilvania; the Tyrol; Carinthia; Bannat of Temeswar; Moravia; in the limestone quarries of Langenfeld in the electorate of Saxony; in the Shetland islands, near Beith in Ayrshire, and in the basaltic rock on which the castle of Edinburgh is built.

Observation.

Actynolite and tremolite are nearly allied; one of the most characteristic distinctions is the green colour, which is characteristic of actynolite, but is rare and only very faint in tremolite. Werner remarks that tremolite is related to actynolite in the same manner as leuzite is to garnet.

SIXTH GENUS.

CALC GENUS.

FIRST SPECIES.

Rock Milk.

Bergmilch.—*Werner*.

Agaricus mineralis, *Wall.* t. 1. p. 30.—Bergmilch, *Wid.* p. 490.—Agaric mineral, *Kirw.* vol. 1. p. 76.—Bergmilch, *Eſtner*, b. 2. f. 914. *Id. Emm.* b. 1. f. 430.—Agaric mineral, *Nap.* p. 333. *Id. Lam.* p. 333.—Lait de montagne ou l'agaric mineral, *Broch.* t. 1. p. 519.—Chaux carbonatée ſpongieuſe, *Hauy*.

External Characters.

Its colour is yellowiſh white, which ſometimes approaches to ſnow white and greyiſh white.

 Compoſed

Compofed of dull dufty particles, which are almoft always weakly cohering.

Feels meagre, yet fine.

Soils very much.

Light, nearly fwimming.

Chemical Characters.

It effervefces powerfully with acids, and is alfo completely diffolved in it. It is a compound of calcareous earth and carbonic acid.

Geognostic and Geographic Situations.

It is found in fiffures and holes of mountains compofed of floetz limeftone, and principally in Switzerland.

Obfervation.

It appears to be formed by meteoric water paffing over limeftone rocks, and afterwards depofiting, in holes and fiffures, the calcareous earth which it had diffolved in its courfe.

SECOND

SECOND SPECIES.

Chalk.

Kreide.—*Werner.*

Creta alba, *Wall.* t. 1. p. 27.—Kreide, *Wid.* f. 492.—
Chalk, *Kirw.* vol. 1. p. 77.—Kreide, *Eſtner*, b. 2.
f. 917. *Id. Emm.* b. 1. f. 433.—Creta commune, *Nap.*
p. 331.—La craiè, *Broch.* t. 1. p. 521.

External Characters.

Its colour is yellowiſh white, which ſometimes alſo approaches to ſnow white and greyiſh white.

It is ſometimes marked with yellowiſh brown ſpots.

Occurs maſſive, diſſeminated, and as cruſt covering flint.

Internally it is dull.

Fracture pretty fine earthy.

Fragments indeterminately angular, blunt edged.

Opaque.

Soils.

Writes.

Very ſoft, and often paſſes into friable.

Feels

Rather mild.

Very eaſily frangible.

Feels meagre, and rather rough.

Light.

Specific gravity.—2,315, *Kirwan.*—2,657, *Watſon.*—2,252, *Muſchenbroeck.*

Chemical Character.

It effervefces ſtrongly with acids. It is compoſed almoſt entirely of lime and carbonic acid.

Geognostic Situation.

It conſtitutes a peculiar kind of formation, which is probably one of the neweſt belonging to the floetz limeſtone. It contains numerous flinty petrefactions, which are principally gloſſopetræ, echinites, pectinites, and chamites. It is alſo remarkable for being the moſt general repoſitory of flint, which occurs either diſſeminated, in tuberoſe-ſhaped maſſes, or in beds that alternate with it.

Geographic Situation.

It is found principally on ſea coaſts, as at Calais and Dover, and ſeveral of the Daniſh iſlands in the Baltic, as Rugen and Seeland. It occurs alſo in Poland,

land, and ſeveral great tracts of conntry in the ſouth of England are compoſed of it.

Uſe.

It is principally uſed for poliſhing and cleanſing metals, glaſs, &c. alſo for white crayons.

THIRD SPECIES.

Limeſtone.

Kalkſtein.—*Werner.*

Werner divides this ſpecies into the following ſubſpecies: 1. Compact limeſtone. 2. Foliated limeſtone. 3. Fibrous limeſtone. 4. Peaſtone.

FIRST SUBSPECIES.

Compact Limeſtone.

Dichter Kalkſtein.—*Werner.*

Of this ſpecies there are two kinds, *a.* Common compact limeſtone. *b.* Roe ſtone.

a. Common

a. Common Compact Limeſtone.

Gemeiner Dichter Kalkſtein.—*Werner.*

Calcareus æquabilis, *Wall.* t. 1. p 122.—Dichter Kalkſtein, *Wid.* p. 494. Compact limeſtone, *Kirw.* vol. 1. p. 82.—Gemeiner dichter kalkſtein, *Emm.* b. 1. f. 437. —Pietra calcarea compacta, *Nap.* p. 33.—La pierre calcaire compacte commune, *Broch.* t. 1. p. 523.

External Characters.

Its moſt common colour is grey, of which the following varieties have been obſerved: yellowiſh, bluiſh, aſh and ſmoke grey. The aſh grey paſſes into greyiſh black, the yellowiſh grey into yellowiſh brown, and into a colour bordering on cream yellow, and into ochre yellow. It alſo occurs blood, fleſh, and peach bloſſom red, but this latter colour is very rare.

It frequently exhibits veined, zoned, ſtriped, clouded, and ſpotted colour delineations; it ſometimes alſo preſents on the rents brown and black coloured arborizations*.

* A very beautiful aſh grey variety, which is found in Carinthia, ſhews a pearly variegated play of colours, whence it is called opaleſcent marble.

It occurs moſt commonly maſſive, alſo in rolled pieces, in a variety of extraneous external ſhapes, and in large tables (as that of Pappenheim).

Internally it is dull.

Fracture ſmall and fine ſplintery, which paſſes ſometimes into large and flat conchoidal, ſometimes into uneven, which approaches to earthy. One variety has a tendency to the ſlaty fracture.

Fragments indeterminately angular, more or leſs ſharp edged.

Tranſlucent on the edges.

Semi-hard.

Brittle.

Pretty eaſily frangible.

Not particularly heavy.

Specific gravity.—From 2,600 to 2,700.

Constituent Parts.

It is principally compoſed of lime and carbonic acid, and a ſmall portion of iron, alumina, and inflammable matter.

Geognostic Situation.

This foſſil conſtitutes ſeveral very diſtinct and highly characteriſtic formations, concerning which a full detail will be given in the Geognoſie, at pre-

ſent

ſent I ſhall only remark, that it is almoſt entirely confined to the floetz mountains.

Geographic Situation.

It occurs in the ſandſtone and coal formations of Saxony, Bohemia, Bavaria, Sweden, France, England, Scotland, &c.

Uſe.

It is frequently uſed for building and the making of roads. When by burning it is deprived of its water and carbonic acid, it is uſed for mortar, and in this ſtate it is alſo employed by the ſoap-maker, the tanner, and the farmer; it is alſovery often uſed as a flux, in the reduction of ſuch ores as are difficultly fuſible, by reaſon of an intermixture of ſilica and alumina.

The florentine arboreſcent marble, which is a variety of this kind, is valued for ornamental purpoſes; and the limeſtone of Pappenheim, when it riſes in thick tables, ſerves for paving ſtones, grave ſtones, and becauſe it does not alter its ſhape, it is ſometimes employed in the poliſhing of plate glaſs for mirrors.

Obſervation.

The bluiſh grey variety often paſſes into marle.

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b. Roeſtone.

Roogenſtein.—*Werner.*

Stalactites—Oolithus, var. *b. c. d. Wall.* t. 2. p. 384.—Roogenſtein, *Wid* ſ 511.—Oviform limeſtone, *Kirw.* vol. 1. p. 91.—Roogenſtein, *Eſtner*, b. 2. ſ. 928.—*Id. Emm* b. 1. ſ. 442.—Tufo oolitico, *Nap.* p. 353.—L'oolite, *Broch.* t. 1. p. 529.

External Characters.

Its colour is hair brown and cheſnut brown, but the conſiderable quantity of marle which it contains makes it yellowiſh grey and aſh grey.

Is maſſive.

Internally dull.

Fracture fine ſplintery, but it is very difficult to obſerve, on account of the ſmallneſs of the diſtinct concretions.

The

The fragments in the large are indeterminately angular and very blunt edged.

It is compofed of fmall and fine grained globular diftinct concretions; the fmall grained include or are compofed of fine grained concretions, which are compofed of concentric lamellar concretions, as in the pea ftone.

Opaque, or at the utmoft only tranflucent on the edges.

Semi-hard.

Brittle.

Very eafily frangible.

Not particularly heavy.

Geognostic Situation.

It occurs in beds, which are interpofed between ftrata of fand ftone, that belong to the fecond fand ftone formation.

Geographic Situation.

It is found in confiderable quantity in the province of Thuringia in Saxony, as at Eifleben, Arterm, Sangerhaufen, Klofteroda, &c.

Uſe.

It is uſed as a manure, but on account of its eaſy diſintegration, it is never employed for building, and its marly nature renders it unfit for mortar.

Obſervation.

It was for a long time conſidered to be an aggregation of petrified fiſh roes, and afterwards it was, by many mineralogiſts, deſcribed as a conglomerate, formed by the union of rolled pieces of limeſtone by a marly cement. It is ſcarcely neceſſary to ſay that theſe opinions are completely erroneous, and that the ſtructure of this foſſil is owing to cryſtallization.

SECOND SUBSPECIES.

Foliated Limeſtone.

Blættriger Kalkſtein.—*Werner.*

This ſubſpecies is by Werner divided into two kinds. *a.* Granular limeſtone. *b.* Calc ſpar.

a. Foliated

a. Granular Limeftone.

Körniger Kalkftein.—*Werner*.

Calcareus micans, *Wall.* t. 1. p. 126.—Calcareus inequabilis, *Id.* p. 128.—Marmor unicolor album, *Id.* p. 133.—Körniger kalkftein, *Wid.* f. 496.—Foliated and granular limeftone, *Kirw.* vol. 1. p. 84.—Körniger kalkftein, *Eftner*, b. 2. f. 931. *Id. Emm.* b. 1. f. 445.—Pierre calcaire grenue, *Broch.* t. 1. p. 531.

External Characters.

Its moft common colour is white, of which it prefents the following varieties: fnow white, yellowifh white, greyifh white, and greenifh white, feldom reddifh white. From greyifh white it paffes into bluifh, greenifh, afh, and fmoke grey, and from the fmoke grey into greyifh black. From the reddifh white it paffes into pearl grey and flefh red, and from yellowifh white into cream yellow. From greenifh white it paffes into fifkin and olive green.

It is generally uniform, feldom marked with fpotted and clouded delineations.

Maffive.

Internally it alternates from fhining to gliftening and glimmering, fome varieties even approach to fplendent,

ſplendent, and is intermediate between pearly and vitreous.

Fracture foliated, and ſometimes, on account of the fineneſs of the grains, it appears ſplintery.

Fragments indeterminately angular blunt edged.

It occurs almoſt always in granular diſtinct concretions, which are coarſe, ſmall, and fine grained; the latter paſſes into compact, and ſometimes is only diſtinguiſhed by its glimmering.

Almoſt always more or leſs tranſlucent, and the black variety is only tranſlucent on the edges.

Semi-hard.

Brittle.

Eaſily frangible.

Not particularly heavy.

Specific gravity—2,700 to 2,800.

Chemical Character.

It uſually effervesces with acids, and is purer than common limeſtone.

Geognostic Situation.

It is peculiar to the primitive and tranſition mountains, and occurs but rarely, and only in ſingle beds in the floetz formations. The oldeſt granular limeſtone in which the concretions are very diſtinct, occurs in gneiſs; but in the newer, which is found in

the tranſition rocks, the concretions are ſcarcely viſible. The intereſting concluſions which Werner has drawn from this fact will be detailed inthe Geognoſie.

It has frequently other foſſils imbedded in it, and of theſe the following occur moſt frequently: mica, hornblende, actynolite, aſbeſt, quartz, ſerpentine, lead glance, blende, iron pyrites, and magnetic iron ſtone.

Geographic Situation.

The ſnow white variety is found peculiarly beautiful at Carrava in Italy, where it is quarried, and from thence diſtributed over Europe for the purpoſes of ſtatuary. The white marble of Paros in the Helleſpontic Archipelago, has been long celebrated on account of its fitneſs for ſculpture and other uſeful and ornamental purpoſes. The architectonic marbles are generally marked with various colour delineations, and are ſuſpected by Werner to belong principally to the tranſition rocks. They are found in the Harz, and in other countries where tranſition rocks occur.

In Scotland we have ſeveral marbles or granular limeſtones, which are remarkable for their beauty. Of theſe, the marble of Tiree is the moſt noted; and next in conſideration are thoſe of Sutherland, Portſoy, and Iſland of Skye *.

* Mineralogy of the Scottiſh iſles.

Uſe.

Use.

It is employed for the ſame purpoſes as common compact limeſtone, but on account of its granular fracture, its higher degree of tranſparency, and its greater variety and beauty of colour, is has alſo, from time immemorial, been uſed by the ſtatuary and architect.

The hiſtory of all the varieties of marbles, with the account of their individual uſes, value, &c. will be given in the volumes of this work that treat of Oeconomical Mineralogy.

Obſervation.

Tournefort, in his voyage to the Levant, informs us that M. Lauthier, ſecretary to the King of France, had in his poſſeſſion a flexible ſandſtone; ſince that time, ſimilar varieties have been imported from Brazil; and more lately, M. Fleuvian de Belvue has diſcovered varieties of granular limeſtone that poſſeſs, in an eminent degree, the ſame property. He has ſucceeded in rendering common granular limeſtone and granular quartz completely flexible, by expoſing them to a certain degree of heat.

 b. Calc-

b. Calc-ſpar.

Kalkſpath.—*Werner.*

Spathum, *Wall.* t. 1. p. 140.—Variety of körniger kalkſtein, *Wid.* ſ. 427.—Common ſpar, *Kirw.* vol. 1. p. 86.—Kalkſpath, *Eſtner.* b. 2. ſ. 941. *Id. Emm.* b. 1. ſ. 455.—Spatho calcareo, *Nap.* p. 341.—Calcaire criſtalliſé, *Lam.* t. 1. p. 29.—Chaux carbonatée criſtalliſée, *Hauy.* t. 2. p. 127.—Le ſpath, calcaire, *Broch.* t. 1. p. 536.—Calcarcous ſpar of Britiſh mineralogiſts.

External Characters.

Its principal colour is white; it occurs alſo frequently grey, green, ſeldom yellow, and very ſeldom roſe red, and pale violet blue. The moſt common varieties of white are greyiſh, yellowiſh and greeniſh white, alſo reddiſh white, but that is rare; the varieties of green are olive, aſparagus, piſtacio, and leek green, which latter paſſes into greeniſh grey.

From yellowiſh white it paſſes into wax and honey yellow, which ſometimes approach to wine yellow, and paſs into yellowiſh grey.

From reddiſh white it paſſes into pearl grey, even into light violet blue, but the red and blue appear to be accidental varieties.

On

On the furface of the cryftallized varieties (we muft except grey and red), a play of colours is to be obferved. The prifmatic varieties are ufually yellow, and of all the colours the yellowifh and greenifh are the moft characteriftic.

Befides maffive and diffeminated, it occurs alfo in crufts, ftalactitical, in globular and amygdaloidal fhaped pieces, in drufes, and kidney fhaped; but it occurs moft frequently cryftallized, and prefents a great variety of cryftallizations.

It poffeffes three fundamental figures to which all its other cryftallizations can be referred, thefe are the

1. Six-fided pyramid.
2. Six-fided prifm, and
3. Three-fided pyramid.

1. *Six fided Pyramid.*

When perfect it is acute, and three alternate lateral edges are more obtufe than the others. It occurs,

1. Simple, and this is either erect or inverted.
   The inverted has three cylindrical concave, and three inwardly bent lateral planes, and on the upper extremity it is flatly acuminated by three planes which are fet on the cylindrically concave lateral planes.
2. Double, where the lateral planes of the one are obliquely fet on the lateral planes of the other, in fuch a manner that the edges of the common

mon bafis form a zigzag line, and the more obtufe lateral edges of the one are oppofed to the lefs obtufe lateral edges of the other pyramid. Of this figure the following varieties occur:

a. The extremity of the pyramid is fometimes more or lefs deeply and flatly acuminated by three fomewhat convex planes, which are fet on the more obtufe lateral edges?

b. The angles of the common bafe are often more or lefs deeply truncated. When the truncating planes become fo large that they touch one another, the tranfition into the fix-fided prifm is formed.

c. The lefs obtufe edges are fometimes bevilled, and the extremities fometimes more or lefs deeply truncated.

d. If two double fix-fided pyramids penetrate one another in the direction of their axis, and one of them is turned around a fixth of its periphery, fo that the lefs obtufe lateral edges of the one cryftal come to be oppofed to the lefs obtufe lateral edges of the other, the refult is, a twin cryftal, reprefenting a double fix-fided pyramid having three alternate re-entering angles at the common bafe, where the more obtufe lateral edges are oppofed to one another.

2. *Six-*

2. *Six-ſided Priſm.*

It occurs uſually with three alternate lateral planes broader than the others, and rather acutely acuminatedby ſix planes which are ſet on the lateral edges, and the acuminating planes meet alternately under more obtuſe angles.

a. The ſame priſm a ſecond time flatly acuminated by three planes which are ſet on the alternate obtuſe lateral edges of the firſt acumination.

b. When the planes of the ſecond acumination enlarge themſelves ſo much that thoſe of the firſt entirely diſappear, thence reſults the ſix-ſided priſm flatly acuminated by three planes, which are ſet on the alternate and alternating lateral planes.

c. The apex of the acumination is often more or leſs deeply truncated, which produces the ſix-ſided priſm in which the alternate and alternating terminal angles are truncated.

d. When the truncation of the apex becomes ſo large that all traces of the acumination diſappear, the perfect ſix-ſided priſm is formed.

e. When the priſm becomes lower, it paſſes into the ſix-ſided table, which is often extremely thin.

3. *Three-*

3. *Three-ſided Pyramid.*

1. Simple three-ſided pyramid, whoſe ſummit angle is of all degrees of magnitude, from obtuſe to acute.
2. If the angles of the preceding figure are ſo deeply truncated that the angles of the truncating planes meet each other, an octaedron is formed.
3. The pyramid is often double, in which caſe the lateral planes of the one pyramid are ſet on the lateral edges of the other. It preſents the following varieties.
   - *a.* Flat double ſix-ſided pyramid, which has ſometimes convex lateral planes.
   - *b.* If a number of theſe flat or obtuſe pyramids are piled on one another, there is formed a ſix-ſided priſm acuminated by three planes, which are ſet on the alternate and alternating lateral planes.
   - *c.* When this pyramid becomes very obtuſe it gives riſe to the lens.
   - *d.* When the ſummits of the pyramid become leſs obtuſe, and approach to right angles, a figure differing but little from the cube is formed.
   - *e.* When the ſummits become ſtill more acute, an acute double three-ſided pyramid is formed.

f. The

f. The acute double three-fided pyramid is fometimes truncated on the lateral edges, fometimes bevilled; in the latter cafe, when the bevilling planes become fo large that the original ones are very fmall, or even difappear, the refult is, an acute double three-fided pyramid, having its plane length-wife divided, or it is a double fix-fided pyramid.

g. If the fummits of the double fix-fided pyramid are deeply truncated, it gives rife to the fix-fided table, having its terminal planes fet on alternately in oppofite directions.

The cryftals are aggregated in a variety of fhapes; thus the flat double pyramids are fometimes difpofed in rows, globularly, or rofe-like. The fix-fided prifms are fometimes fcalarwife, fcopiformly and globularly aggregated.

The acute three-fided pyramids are fometimes hollow.

The lateral planes of the cryftals are commonly fmooth and fhining and fplendent; fometimes alfo gliftening and dull.

Internally its luftre alternates from fplendent and fpecularly fplendent to fhining and gliftening, and is moft commonly vitreous, which in fome varieties inclines a little to refinous, in others to pearly. In general the intenfity of the luftre correfponds with the tranfparency. It is fometimes pretty perfectly pearly on the furface.

Fracture almoſt always perfectly foliated, moſt commonly ſtraight foliated, ſeldom ſpherically curved foliated. It ſhews a threefold cleavage. Sometimes has a concealed foliated fracture.

Fragments rhomboidal.

The maſſive occurs in very large and coarſe grained diſtinct concretions, ſeldom ſmall grained; alſo in thick and thin priſmatic diverging and interſecting concretions, which are obliquely longitudinally ſtreaked; alſo in wedge-ſhaped priſmatic concretions, which are alſo deeply and obliquely ſtreaked.

The maſſive varieties are tranſlucent, and ſometimes even tranſparent. Cryſtals tranſparent and ſemitranſparent. The tranſparent varieties are alſo duplicating.

Semi-hard,

Brittle.

Very eaſily frangible.

Not particularly heavy.

Specific gravity.—2,700.

Conſtituent Parts.

It is compoſed of lime and carbonic acid in the proportion of 35 to 34 in the hundred. Its water of cryſtallization is very inconſiderable, being, according to Bergman, in the 100 parts.

Phyſical

Phyſical Character.

Many varieties of calc ſpar, as Mr Hatchett informs me, become phoſphoreſcent when laid on burning coal. Hauy has made a ſimilar obſervation.

Geognostic Situation.

It occurs venigenous in almoſt every rock, from granite to the neweſt floetz trap; it is even found in alluvial land. The veins are ſometimes very new, but others are ſo old as to be nearly of cotemporaneous formation with the rocks in which they run. It alſo frequently lines druſy cavities.

Occurs in a great variety of mineral veins, and in many of them it characteriſes the formation.

Geographic Situation.

It is ſo univerſally diſtributed that an enumeration of its localities would be unneceſſary in a work like the preſent; therefore I ſhall only mention, that many of its moſt beautiful and rare cryſtallizations are found in Derbyſhire in England, in Ireland, Saxony, France and Spain; each country affording peculiar varieties, which no doubt, in many caſes, correſpond with the different mineral vein formations in the diſtricts where they occur.

Obſervations

Obſervations.

1. Brochant remarks, that the Wernerian deſcription of calc-ſpar is not ſufficiently minute, and therefore he finds it neceſſary to ſubjoin the cryſtalometrical obſervations of Hauy. However amuſing the minute meaſurements of Hauy may be, they are of little or no uſe to the oryctognoſt, they cannot therefore find a place in this work. The preceding deſcription of calc ſpar, which I have drawn up according to the Wernerian method, will enable us not only to diſtinguiſh calc ſpar from all other foſſils, but to know its moſt remarkable varieties.

2. Brochant informs us that the fine rhomboidal calc ſpar of Iceland is obtained by ſplitting double ſix ſided pyramids.

3. The rhomboidal calc ſpar of Fontainbleau differs from the common varieties, by having an intermixture of ſandy particles.

THIRD SUBSPECIES.

Fibrous Limeftone.

This fubfpecies is divided into two kinds : *a.* Common fibrous limeftone. *b.* Fibrous Limeftone, or calc finter.

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a. Common Fibrous Limeftone.

Gemeiner Fafriger Kalkftein..—*Werner.*

External Characters.

Its colours are greyifh, reddifh, and yellowifh white.

Occurs maffive.

Its luftre is gliftening, and fometimes fhining, and is pearly.

Fracture coarfely, delicately, ftraight, and parallely fibrous, which fometimes borders on radiated.

Fragments fplintery.

more

More or lefs tranflucent.

Semi-hard.

In its other characters it refembles the preceding fubfpecies.

Geognostic Situation.

Occurs only in fmall veins.

Obfervations.

1. It has a confiderable refemblance to fibrous gypfum, from which it is diftinguifhed, however, by its fuperior hardnefs, and fharper afpect.

2. It has been fometimes confounded with zeolite; but it is fufficiently diftinguifhed from it by its inferior luftre, greater hardnefs and fpecific gravity, and its never occurring with a diverging fibrous fracture.

3. The fattin fpar found in Derbyfhire belongs to this kind.

b. Calc Sinter.

Kalkſinter.—*Werner.*

External Characters.

Its moſt common colour is white, of which it preſents the following varieties: ſnow, greyiſh, greeniſh, and yellowiſh white. The yellowiſh white paſſes into wax and honey yellow, and yellowiſh brown. It occurs alſo ſiſken, piſtacio, aſparagus, mountain, and verdegris green; which latter paſſes into ſky blue. Sometimes it is fleſh red, peach bloſſom red, and reddiſh brown.

The laſt mentioned varieties are rare, and receive their colour from the mineral ſubſtances that occur in the vein along with them: thus the peach-bloſſom red is derived from cobalt, the verdigris green from copper, the ſiſkin green from nickel, and the fleſh red from manganeſe.

The only colour delineation is the ſtriped.

It occurs moſt commonly maſſive, alſo in many particular external ſhapes, as reniform, botroidal, tubular, and coralloidal, but more commonly ſtalactitic, and tuberoſe.

Its ſurface is either rough or druſſy; and frequently branches are terminated by a cryſtal.

Internally

Internally its luſtre is moſt commonly glimmering, ſometimes paſſing to gliſtening, and is pearly.

Fracture ſtraight, ſcopiformly, and ſtellularly diverging fibrous; and is from very delicately fibrous to coarſe fibrous, which is nearly radiated.

Fragments ſometimes indeterminately angular, ſeldom ſplintery and wedge-ſhaped.

It occurs moſt commonly in curved lamellar diſtinct concretions, which are bent in the direction of the external ſurface; in the ſtalactitic and tubular varieties it has cylindrical convex concretions. Sometimes, although rarely, we find it in large and coarſe grained diſtinct concretions.

More or leſs tranſlucent, and ſome varieties approach to ſemi-tranſparent.

Semi-hard, approaching to ſoft.

Brittle.

Eaſily frangible.

Not particularly heavy.

Geognostic Situation.

It is found ſtalactitic and tubular, alſo reniform, botroidal, and in cruſts, that hang from, or cover the roofs, walls, and floors of caves, which are uſually in limeſtone.

The beautiful coralloidal variety, the flos ferri of ſome mineralogiſts, is found in veins of ſparry iron ſtone. From its peculiar external ſhape, and its occurrence in druſy cavities, I am inclined to believe it ought

ought perhaps to be confidered, either as a groupe of cryftalline fhoots, or as an aggregation of cryftals, than as ftalactitic.

M. Patrin, who is advantageoufly known by his mineralogical refearches, adduces the flos ferri as an inconteftible proof of the truth of the exploded opinion of the vegetation of ftones.

Geographic Situation.

The Grotto of Antiparos, the Baumans Cave in the Harz, and the Balme in Switzerland, all afford ftriking inftances of calc finter. It would be tedious to give more inftances of what occurs in almoft every limeftone country.

Ufes.

When it occurs in large maffes it is ufed by the ftatuary for many of the purpofes of marble. The alabafter of the ancients, or what is called oriental alabafter, is calc finter. It was brought from Arabia in confiderable quantities, and ufed principally for the drapery of marble ftatues. It is ftill ufed by the Italians, and is named by them Marmo Alabaftrino.

Obfervations.

1. Brochant informs us that certain varieties of it are fo porous as to allow water to percolate, and are on that account employed as filtering ftones.

2. Many of the great caves in limeftone countries are formed by maffes of limeftone, irregularly heaped on one another, and connected by calc finter.

FOURTH SUBSPECIES.

Peaſtone.

Erbſenſtein.—*Werner.*

La pierre de pois, ou la piſolite, *Broch.* t. 1. p. 555.

External Characters.

Its moſt common colour is yellowiſh white, which ſometimes approaches to ſnow white; from yellowiſh white it paſſes into light yellowiſh brown.

Commonly maſſive, ſeldom reniform.

Internally it is dull.

Fracture, when it can be obſerved, even.

Fragments in the great indeterminately angular blunt edged.

It is compoſed of ſpherically round diſtinct concretions, which are coarſe and ſmall grained, and ſometimes approach to fine grained; theſe are again compoſed of very thin and concentric curved lamellar concretions.

Opaque, or tranſlucent on the edges.

Soft, approaching to very ſoft.

Not remarkably brittle.

Very eaſily frangible.
Not particularly heavy, approaching to light.

Geographic and Geognostic Situations.

It is found in great maſſes in the vicinity of the hot ſprings at Carlſbad in Bohemia. According to Werner it is formed in the following manner: Particles of ſand appear to be raiſed in the water by means of air bubbles, and become covered with calcareous earth, which is depoſited around them in lamellar concretions; at length the globular concretions thus formed acquire ſo much ſpecific gravity that they fall down, and being agglutinated give riſe to peaſtone. What renders this explanation very probable is the almoſt conſtant occurrence of particles of ſand in the middle of the globular concretions. Sometimes, but that is a rare caſe, the interior of the concretions is filled with air.

FOURTH

FOURTH SPECIES.

Schaum Earth, or Foaming Earth.

Schaumerde,—*Werner.*

Id. Emm. b. 1. f. 484.—Schaum Kalk, *Len.* 2. p. 392.—Silvery Chalk, *Kirw.* vol. 1. p. 78.—L'ecume de terre, *Broch.* t. 1. p. 557.

External Characters.

It has a very light yellowifh, nearly filver white colour, and fometimes approaches to greyifh white.

Occurs maffive and diffeminated, alfo fometimes loofe and compofed of fine fcaly particles, or intermediate between friable and loofe.

Its luftre is intermediate between fhining and gliftening; the loofe varieties are glimmering, and intermediate between femi-metallic and pearly, but incline more to the latter.

Generally

Fracture curved foliated, ſingle cleavage, and paſſes into ſmall ſcaly.

Fragments indeterminately angular, blunt edged.

Preſents large, coarſe, ſmall, and fine grained diſtinct concretions.

Generally opaque.

Soils a little.

Very ſoft.

Mild.

Moſt generally completely friable.

Feels fine, but not greaſy.

Creaks a little.

Light.

Chemical Characters and Constituent Parts.

It makes a very briſk effervescence with acids, and is diſſolved in them. According to Wiegleb it is a compound of lime and carbonic acid.

Geognostic Situation.

It occurs in cavities of the oldeſt floetz limeſtone.

Obſervation.

Geographic Situation.

It is found in the neighbourhood of Gera in the foreſt of Thuringia; alſo in the north of Ireland?

Obſervation.

According to Werner it is very nearly allied to ſlate ſpar.

FIFTH

FIFTH SPECIES.

Slate Spar.

Schiefer Spath.—*Werner.*

Id. Wid. f. 513.—Argentine, *Kirw.* vol. 1. p. 105?—Schifto fpatho, *Nap* p. 355.—Schiffer fpath, *Lam.* t. 1. p. 385.—Le fpath fchifteux ou le fchiefer fpath, *Broch.* t. 1. p. 558.

External Characters.

Its colour is milk, greenifh and reddifh white.

Maffive.

Luftre intermediate between fhining and gliftening, and is completely pearly.

Fracture pretty perfectly common curved foliated, approaching fometimes to ftraight flaty, fometimes to undulating flaty; cleavage is fingle.

Fragments flaty.

Exhibits fometimes a tendency to large, and coarfe grained diftinct concretions, feldom curved lamellar diftinct concretions.

Tranflucent.

Soft.

Intermediate

Intermediate between mild and brittle.
Pretty eafily frangible.
Not particularly heavy.

Constituent Parts.

Almoft entirely compofed of carbonate of lime.

Geognoftic Situation.

It occurs in limeftone beds in primitive mountains.

Geographic Situation.

It is found at Königfberg in Norway; at Bergrun, near Schwartzenberg in Saxony, where it is accompanied with lead glance and brown blende; and in Cornwall.

SIXTH SPECIES.

Brown ſpar.

Braun ſpath.—*Werner.*

Spath perlé, *R. d. L.* t. 1. p. 605. — Braunſpath, *Wid.* ſ. 515.—Sidero-calcite, *Kirw.* vol. 1. p. 105.—Braunſpath, *Eſtner*, b 2. ſ. 999. *Id. Emm.* b. 1. ſ. 79.—Bruniſpato, *Nap.* p. 356.—Le ſpath bruniſſant on le braunſpath, *Broch.* t. 1. p. 563.

Werner divides this ſpecies into two ſubſpecies.

1. Foliated brown ſpar.
2. Fibrous brown ſpar.

FIRST SUBSPECIES.

Foliated brown ſpar.

Blättriger braunſpath.—*Werner.*

External Characters.

Its principal colour is white and red. Of white it preſents the following varieties, greyiſh, yellowiſh, but principally reddiſh white; from reddiſh white it paſſes into fleſh red, roſe red, and browniſh red, and into brown. The yellowiſh white variety ſometimes borders on yellow. Some varieties approach to pearl grey, others to black.

It is ſometimes ſpotted, and this is moſt frequently the caſe with the red coloured varieties.

Occurs maſſive, diſſeminated, globular, with tabular impreſſions, and very often cryſtallized in curved and ſtraight planed rhombs, and in ſpherical lenſes; from theſe ariſe the following figures:

1. The flat double three-ſided pyramid having convex lateral planes. It is ſometimes hollow.
2. Acute double three-ſided pyramid, which is again flatly acuminated by three planes.

3. An

3. Oblique angular ſix-ſided pyramid, in which the alternate edges are obtuſer than the others.

The lens occurs ſingle or in rows.

Surface of the cryſtals uſually druſy; the rhombs, however, are ſmooth.

Externally its luſtre is ſhining; internally it alternates from ſhining to ſplendent, but more frequently gliſtening, and is always pearly.

Fracture very frequently ſtraight, but moſt generally ſpherically curved foliated, and has a threefold obliquely interſecting cleavage like calc ſpar.

Fragments rhomboidal.

Occurs in granular diſtinct concretions of all degrees of magnitude, but ſeldom fine grained; alſo in ſtraight lamellar concretions, which are very much grown together.

More or leſs tranſlucent, paſſing into tranſlucent on the edges; the cryſtals ſemitranſparent*.

Semi-hard.

Not particularly brittle.

A little difficultly frangible.

Not particularly heavy, approaching to heavy.

It is heavier than calc ſpar, but lighter than heavy ſpar.

Specific gravity.—2,837.

* When the tranſparency is very conſiderable it paſſes into calc ſpar.

Chemical

Chemical Character.

By expofure to the blow pipe it hardens, and becomes dark brownifh black; it effervefces faintly with acids, if not previoufly pulverifed.

Constituent Parts

Carbonate of lime	50
Oxyd of iron	22
——— Manganefe	28
	100

According to *Bergman.*

Geognostic Situation.

Occurs principally in veins, and is generally accompanied with calc fpar, and fparry iron ore, and fometimes with different fpecies of ore, as lead glance, blende, pyrites, native filver, and various ores of filver. In the mining field of Freyberg it is one of the principal vein ftones, and is confidered as indicating rich burfts of filver ore.

Geographic

Geographic Situation.

It is found in the mines of Norway, England, the Harz, Sweden, Saxony, Swabia, France, and Hungary.

Obſervations.

1. It is diſtinguiſhedfrom calc ſpar, with which it is often confounded by its particular ſuite of colours, leſs tranſparency, complete pearly luſtre, greater hardneſs, and greater ſpecific gravity.

2. The ſtraight lamellar variety has been miſtaken for lamellar heavy ſpar, from which, however, it is diſtinguiſhed not only by its inferior weight, but alſo by the concretions being very intimately joined together, which is not the caſe with heavy ſpar.

3. On expoſure to the air it changes to brown, and even verges on black, and the ſame effect is produced by heating; on this account it received the name of Brown ſpar.

SECOND SUBSPECIES.

Fibrous brown Spar.

Fafriger braunfpath.—*Werner.*

External Characters.

Its colour is flefh red, paffing into rofe red.

Occurs maffive.

Luftre gliftening.

Fracture ftraight and diverging fibrous, generally rather coarfely fibrous.

Fragments fplintery and wedge-fhaped.

Prefents indeterminately angular, fometimes large and coarfe grained diftinct concretions.

In other characters it refembles the preceding fubfpecies.

Geographic Situation.

It has been hitherto found only in Hungary and Tranfilvania.

SEVENTH SPECIES.

Rhomb-ſpar.

Rautenſpath.—*Werner.*

Bitterſpath, *Wid.* ſ. 518.—Criſtallized muricalcite, *Kirw.* vol. 1. p. 92.—Bitterſpath, *Emm.* b, 3. ſ. 353.—Spato magneſiano, *Nap.* p. 358. *Id. Lam.* t. 2. p. 347.—Chaux carbonate magneſiée, *Hauy.*—Le ſpath magneſien ou le bitterſpath, *Broch.* t. 1. p. 560.

External Characters.

Its colours are greyiſh and yellowiſh white and yellowiſh grey, which latter ſometimes paſſes into pea yellow.

Never maſſive, but always in regular middle ſized rhombs.

Luſtre ſplendent, and intermediate between vitreous and pearly.

Fracture ſtraight foliated, and has a three-fold obliquely interſecting cleavage; croſs fracture uneven, and imperfectly and flat conchoidal.

Generally intermediate between tranſlucent and ſemi-tranſparent.

Semi-

Semi-hard.
Brittle.
Eafily frangible.
Specific gravity.—2,480.

Chemical Character.

Before the blow pipe it is infufible without addition. It produces very little effervefcence with acids, even when powdered.

Constituent Parts.

According to Klaproth, b. 1. f. 304, it affords,

	From the Tyrol.	From Sweden.
Carbonate of lime	52	73,0
Carbonate of magnefia	45	25,0
Oxyd of iron and manganefe	3	2,25
	100	100,25

Geognostic Situation.

Occurs imbedded in rocks that belong to the talc genus, fuch as chlorite and talc flate.

Geographic Situation.

It is found at Brienz in Switzerland; in the mountains of the Tyrol and Salzbourg; and at Taberg in Wermeland in Sweden. It occurs alſo in chlorite rocks on the banks of Loch Lomond in Scotland.

Obſervations.

1. Brochant and other French mineralogiſts are of opinion that this ſpecies and brown ſpar, are merely accidental varieties of calc ſpar. That this opinion is unfounded muſt be evident to every one who comprehends fully the preceding Wernerian deſcriptions.

2. The yellowiſh variety approaches to ſparry iron ſtone.

3. It is named rhomb ſpar from its cryſtallization; its former name bitter-ſpar, intimated that it contained magneſian earth.

EIGHTH

EIGHTH SPECIES.

Schaalſtone.

Schaalſtein.—*Werner.*

External Characters.

Its moſt common colour is greyiſh white, which ſometimes paſſes into greeniſh and yellowiſh white, and reddiſh white.

Occurs maſſive.

The luſtre of its principal fracture is ſhining and nearly pearly.

Principal fracture foliated, with a ſlight tendency to ſplintery, and coarſe fibrous. Cleavage ſingle, and rather imperfect.

Occurs in ſtraight and thin lamellar diſtinct concretions, which are collected into other large and broad priſmatic diſtinct concretions, that paſs into long and coarſe grained concretions. The poſition of the concretions is promiſcuous.

Tranſlucent.

Semihard in a pretty high degree.

Brittle.

Eaſily frangible.
Not particularly heavy.

Geognostic and Geographic Situations.

It has been hitherto found only in the Bannat of Temeſwar, and is accompanied by ores of copper.

Obſervations.

1. Some ſpecimens appear to paſs, or to be nearly allied to zeolite.

2. It is named ſchaalſtone, which in German intimates that it is compoſed of lamellar diſtinct concretions. I have not been able to find any Engliſh word ſynonymous to the German, ſo that I am under the neceſſity of adopting it.

3. It is compoſed of lime and ſilica.

NINTH

NINTH SPECIES.

Stink Stone.

Stinkſtein.—*Werner.*

Spathum frictione fœtidum, lapis ſuillus, *Wall.* t. 1. p. 148.—Swine ſtone, *Kirw.* vol. 1. p. 89.—Stinkſtein, *Wid.* ſ. 521.—*Id. Eſtner*, b, 2. ſ. 1023.—*Id. Emm.* b. 1. ſ. 487.—Pierre calcaire puante ou pierre puante, *Lam.* t. 2. p. 58.—Chaux carbonate fetide, *Hauy.* La pierre puante, *Broch.* t. 1. p. 567.

External Characters.

Colour is wood brown, which paſſes on the one ſide into yellowiſh brown, on the other into browniſh and greyiſh black *.

Occurs maſſive, and ſometimes diſſeminated through gyps.

Internally its luſtre is from dull to glimmering, according to the kind of fracture.

Fracture commonly earthy, and extremely ſmall and fine ſplintery; ſometimes the varieties having a

* The greyiſh black is the marble of Brabant.

ſplintery

ſplintery fracture, ſhow a tendency to ſlaty*, and the black variety has a conchoidal fracture.

Fragments indeterminately angular, not particularly ſharp edged, and ſlaty.

Sometimes preſents very ſmall grained diſtinct concretions.

Tranſlucent on the edges or opaque.

Paſſes from ſemi-hard to ſoft.

Not particularly brittle.

Eaſily frangible.

When rubbed, emits an urinous ſmell.

Not particularly heavy.

Chemical Properties.

When expoſed to heat it loſes its colour and ſmell, and is converted into quick lime. It effervesces powerfully with acids. *Brochant.*

Constituent Parts.

Beſides lime and carbonic acid, which are its principal conſtituent parts, according to Vauquelin, it contains-hydr ſulphure, which is the cauſe of the ſmell it emits when rubbed.

* The yellowiſh brown variety is moſt commonly ſlaty.

Geognostic

Geognostic Situation.

Found principally in beds, alternating with, or intermixed with the oldeſt floetz gyps.

Geographic Situation.

Occurs in conſiderable quantities in the diſtrict of Mansfeld in Thuringia.

Obſervations.

1. The light coloured varieties are the ſofteſt, the dark the hardeſt.
2. It muſt not be confounded with bituminous lime-ſtone.

TENTH SPECIES.

Marle.

Mergel.—*Werner.*

This ſpecies is by Werner divided into two ſub-ſpecies

1. Marle Earth ; 2. Indurated Marle.

FIRST SUBSPECIES.

Marle Earth.

Mergel Erde.—*Werner*.

Mergel erde, *Wid.* f. 523.—Earthy marle, *Kirw.* vol. 1. p. 94. Mergelerde, *Eſtner*, b. 2. f. 1027.—*Id. Emm.* b. 1. f. 491 —Marna terrofa, *Nap.* p. 360.—La marna terrofa, *Broch.* t. 1. p. 569.

External Characters.

Its colour is yellowifh grey.
Compofed of dull dufty particles.
Feels rather meagre.
Soils a little.
Sometimes loofe, fometimes cohering.
Light, paffing into fwimming.

Ufe.

It is principally employed for improving bad land.

Obſervation.

It has been conjectured to be diſintegrated, indurated marle; but of this we have no proof. *Vid. Brochant.*

Geographic Situation.

Is found in Thuringia.

SESOND SUBSPECIES.

Indurated Marle.

External Characters.

Smoke grey, and ſometimes yellowiſh grey.

Occurs maſſive.

Luſtre dull, and ſometimes glimmering, which latter is owing to an admixture of foreign particles.

Fracture commonly earthy, ſometimes ſplintery, or imperfectly ſlaty.

Fragments

Fragments indeterminately angular, and partly ſlaty.

Opaque, at the útmoſt weakly tranſlucent on the edges.

So ſoft as to yield to the nail.

Not particularly brittle.

Eaſily frangible.

Not particularly heavy.

Chemical Characters.

It melts before the blow pipe into a greyiſh black glaſs; it makes a briſk efferveſcence with acids.

Geognostic Situation.

Occurs principally in beds in the floetz lime-ſtone, and independent coal formations; in the firſt it alternates with beds of lime-ſtone, and ſometimes occurs in neſts in it.

Geographic Situations.

It is found in the coal works in the vicinity of Dreſden, in thoſe of Wehrau, and in many other places where the floetz lime-ſtone and coal formations occur.

Uses.

It is employed in improving bad land; as mortar; and when limeſtone is not to be found, in the ſmelting of certain ores of iron.

Obſervations.

1. It falls in the air.

2. It paſſes into limeſtone and indurated clay, which latter I ſuſpect has been confounded by Dr. Reuſs, with baſalt, when he ſpeaks of marle paſſing into baſalt.

3. According as alumina or ſilica preponderates, it receives the name of clay or lime marle. Hauy believes it to be a mechanical mixture, and ſays it ſhould not be conſidered as a mineral ſpecies. To the eye, however, it has every character of a ſimple foſſil, therefore it is entitled to a place in a ſyſtem of oryctognoſie.

ELEVENTH SPECIES.

Bituminous Marle Slate.

Bituminöfer Mergel Schiefer.—*Werner.*

Bituminöfer mergel fchiefer, *Wid.* f. 526.—Bituminous marlite, *Kirw.* vol. 1. p. 103.—Bituminöfer mergel fchiefer, *Eftner*, b. 2. f. 1035.—*Id. Emm.* b. 1. f. 498.—Schifto marno bituminofo, *Nap.* p. 363.—Le Schifte marno bitumineux, *Broch*, t. 2. p. 574.

External Characters.

Its colour is to be confidered as intermediate between greyifh and brownifh black.

Maffive.

Luftre either glimmering, gliftening, or fhining.

Fracture curved or ftraight flaty.

Fragments flaty.

Opaque.

Ufually foft.

Somewhat mild.

Not particularly brittle.

Eafily frangible.

Streak fhining, but produces no change of colour.

Not particularly heavy, approaching to light.

Geognostic

Geognostic Situation.

Occurs in beds along with the oldeſt floetz limeſtone. It is frequently intermixed with ores of copper, as copper pyrites, copper glance, variegated copper ore, and rarely with copper green, copper azure, and native copper.

It contains a great number of petrified fiſh, that appear to be of the ſame ſpecies; and they are generally converted into coal, and ſometimes the ſcales into copper ore. From the contorted aſpect of theſe petrifactions, Werner is of opinion, that the fiſh have been ſuddenly killed by an inruption, or inſtantaneous formation of the ſulphureo-metallic matter. Accompanying the fiſh, petrified plants are found, which appear to belong to the genus Fucus.

Uſe.

As it is frequently intermixed with copper ores, it is ſometimes ſmelted; in Thuringia, very extenſive works are eſtabliſhed for the extraction of copper from it.

TWELFTH SPECIES.

Calc Tuff.

Kalk Tuff.—*Werner.*

External Characters.

Colour yellowiſh grey, which ſometimes approaches to ſmoke grey.

Seldom maſſive, generally perforated, or marked with impreſſions of reeds, graſs or moſs; alſo amorphous, ramoſe, and corroded.

Internally, luſtre dull, ſeldom faintly glimmering.

Fracture is intermediate between fine grained uneven and earthy; it ſeldom inclines a little to fibrous and foliated.

Fragments indeterminately angular and blunt edged.

Opaque, and ſometimes tranſlucent on the edges.

Soft, paſſing into very ſoft.

Somewhat mild.

Eaſily frangible,

Light, approaching to ſwimming.

Geognostic Situation.

Occurs in alluvial land.

Geographic Situation.

Found near Langenſalza in Thuringia, at Weimar, Gotha, and in many other places where ſprings impregnated with lime occur.

THIRTEENTH

THIRTEENTH SPECIES.

Arragone.

Arragonite.

Arragone.—*Werner.*

Arragon ſpar, *Kirw.* vol. 1. p. 87.—Arragonite, *Eſtner*, b. 2. ſ. 1039.—*Id. Emm.* b. 5. p. 357.—L'Arragonite, *Broch.* t. 1. p. 576. *Id. Hauy.* t. 4. p. 337.

External Characters.

Colours are greeniſh grey, and pearl grey; the greeniſh grey paſſes into mountain green, and the pearl grey into pale violet blue; both colours are united in a particular manner.

In certain rare varieties it is ſpotted red and brown, which is owing to intermixed parts.

It is always cryſtalliſed.

1. In perfect equiangular ſix-ſided priſms.
2. Six-ſided priſms, in which two oppoſite lateral planes are broader, and four ſmaller. Sometimes the edges formed by the meeting of the ſmaller lateral planes are bevilled, and the edges of the bevillment are alſo ſometimes deeply truncated.—*Estner.*

The cryſtals ſometimes adhere to one another, and form alſo a peculiar kind of twin cryſtal; are middle

ſized, ſmall, and very ſmall; and are long, and ſometimes ſo ſhort as to appear tabular.

Surface very rarely quite ſmooth, almoſt always druſy, or longitudinally ſtreaked, but commonly ſmooth in the middle; terminal planes, rough.

Luſtre gliſtening, paſſing into ſhining, and is vitreous.

Fracture intermediate between imperfectly foliated and coarſe, and ſmall, and parallely fibrous.

Colour arranged in the direction of the fibres, the longitudinal fibres green, the tranſverſe ones violet blue.

Fragments indeterminately angular.

Tranſlucent, and duplicating tranſparent.

Semi-hard, but in a higher degree than calc-ſpar, which it ſcratches.

Brittle.

Not particularly heavy.

It phoſphoreſces a little.

Specific gravity, *Hauy*, 2,9465.

Chemical Characters.

It efferveſces with acids.

Conſtituent Parts.

From its reſemblance to the following ſpecies, Werner is of opinion that it may contain a ſmall portion

portion of phofphoric acid, neither Klaproth nor Thenard, however, have been able to detect in it, any thing befides lime and carbonic acid.

Geognostic and Geographic Situation.

It was firft difcovered in the province of Arragon in Spain, (whence its name,) where it is imbedded in gyps. More lately the induftrious geognoft Von Buch, has found it accompanied by fluor fpar, and heavy fpar, in drufes of a metalliferous bed, which lies in tranfition rocks in the valley of Leogang, in the county of Salzbourg *. It is faid alfo to have been found in France, and in the Pyrenean mountains.

Obfervation.

Its fpecific gravity makes it intermediate between calc fpar, and appatite.

* Von Buchs Geognoftifche beobachtungen auf Reifen durch Deutfchland und Italien, b. 1. f. 225.

FOURTEENTH SPECIES.

Appatite.

Apatit.—*Werner.*

Phofpholite, *Kirw.* vol. 1. p. 128.—Gemeiner apatit, *Wid.* f. 528.—Phofphorite, *Eflner,* b. 2. f. 1049. *Id. Emm.* b. 1. p. 502.—Fosforite lamellare, *Nap.* p. 367.—Apatite, *Lam.* t. 2. p. 85.—L'apatite commune, *Broch.* t. 1. p. 580.

External Characters.

Its moft common colours are white, green, blue, and red; all the pale colours have an intermixture of grey. Of white it prefents the following varieties: greyifh, reddifh, yellowifh, and feldom greenifh white; from which it paffes into mountain, feladon, piftacio, and leek green; and fometimes into olive green. It occurs alfo rofe and flefh red, and pearl grey, from which it paffes into violet blue, and lavender blue, and feldom into indigo blue. Sometimes it is alfo light yellowifh brown.

All the colours are rather light.

Very

Very ſeldom maſſive, almoſt always cryſtalliſed.

Its radical cryſtallization is the equiangular ſix-ſided priſm, which is almoſt always low, and ſometimes even paſſes into the ſix-ſided table.

It is ſometimes truncated on the lateral edges and angles, and often on the terminal edges.

The truncations of the terminal edges ſometimes become ſo large as to paſs into acuminating planes, and thus a ſix-planed acumination is formed; the truncations on the lateral edges form eight and twelve-ſided priſms.

The lateral planes are generally longitudinally ſtreaked, but the acuminating planes are ſmooth.

The cryſtals are middle ſized and ſmall, often bulging, and nearly round.

Externally it is ſplendent.

Internally its luſtre is only ſhining, and reſinous, approaching to vitreous.

Fracture imperfectly foliated; has a four-fold cleavage, of which three of the cleavages are parallel with the lateral planes, and one with the terminal planes, as is the caſe with beryll. Croſs fracture is more or leſs uneven, approaching to the ſmall conchoidal.

Fragments indeterminately angular, not particularly ſharp edged.

The maſſive occurs in coarſe grained diſtinct concretions.

Commonly tranſparent, alſo ſemi-tranſparent, even paſſing to ſtrongly tranſlucent.

Semi-hard but in a leſs degree than fluor.

Brittle.

Brittle.

Eafily frangible.

Not particularly heavy, yet confiderably heavier than calc fpar, and rather lighter than fluor fpar.

Chemical Characters.

When laid on ignited coals it emits a green light; is almoft entirely foluble in nitric acid.

Constituent Parts.

According to Klaproth it contains,

Lime	0,55
Phofphoric acid	0,45

Phyfical Characters.

By rubbing it fhews figns of electricity.

Geognostic Situation.

It occurs in tin veins, and is ufually accompanied with fluor fpar, brown fpar, quartz, lithomarge, molybdæna, fteatite, wolfram, and copper and arfenical pyrites.

Geographic

Geographic Situation.

It is found at Ehrenfriederſdorf and Schneeberg in Saxony; at Kuttenberg and Schlackenwalde in Bohemia; and in Cornwall in England.

Obſervations.

1. It was at one time conſidered as a ſpecies of ſchorl, afterwards, on account of its colour and cryſtallization, it was arranged with Beryll; others deſcribed it as fluor; but Werner ſoon found that it was a new ſpecies, and from its external characters gave it its preſent place in the ſyſtem.

2. Its fallacious reſemblance to other minerals induced Werner to give it this name, which is derived from the Greek word απατάω, to deceive.

3. Lately the chemiſt Trommſdorf confounded it with beryll, and equally erroneouſly ſtated that it contained a new earth, to which he gave the name of Auguſtite.

FIFTEENTH SPECIES.

Afparagus, or Spargel Stone.

Spargelftein.—*Werner.*

Id. Eftner, b. 2. f. 1045. *Id. Emm.* b. 3. f. 359.—Chaux phofphatée verte, *Hauy*, t. 2. p. 237.—La pierre d'afperge, *Broch.* t. 1. p. 586.

External Characters.

Its principal colour is afparagus green, which in fome varieties paffes into greenifh white; fometimes it approaches to piftacio green; and other varieties have a colour which is intermediate between orange and yellowifh brown.

It occurs only cryftallifed, and that in equiangular fix-fided prifms, which are obtufely (but not fo obtufe as appatite) acuminated by fix planes, which are fet on the lateral planes; the lateral edges are alfo truncated.

The

The planes are generally longitudinally ſtreaked, alſo ſmooth.

The cryſtals are imbedded, and all around cryſtallised, and are commonly middle ſized, and ſmall.

Internally its luſtre is ſhining, paſſing into ſplendent, and is vitreous.

Fracture concealed foliated, paſſing into uneven, and perfectly conchoidal, and appears to have a threefold cleavage parallel with the lateral planes, alſo a ſmall conchoidal croſs fracture.

Fragments indeterminately angular.

Moſt frequently tranſlucent, and ſometimes nearly tranſparent.

Semi-hard approaching to ſoft.

Eaſily frangible.

Brittle.

Not particularly heavy.

Specific gravity—3,098.

Chemical Characters.

It diſolves in the nitrous acid with effervefcence, but does not exhibit a phoſphoric light when laid on coals.

Conſtituent Parts.

Lime	53,32
Phoſphoric acid	45,72

According to *Vauquelin.*

Geographic Situation.

Its geognoſtic ſituation, is ſtill very imperfectly known. It has been hitherto found at Caprera, near Cape de Gate, in the kingdom of Murcia in Spain, and a bluiſh variety? has been found at Langloe, near Arendal in Norway.

Obſervations.

1. It is diſtinguiſhed from appatite, with which it has been often confounded, by the following characters:—1. Its aſparagus green colour. 2. Its ſtructure, which is concentric lamellar. 3. The generally ſmooth ſurface of the planes. 4. Its acuter acuminations. 5. Its difference in ſpecific gravity. To theſe may be added, 6. Its non-phoſphoreſcence when laid on coals; and 7. Its ſolution in acids without effervefcence?

2. It was by Romé de Liſle confounded with chryſolite; but Werner, by a careful examination of its characters,

characters, difcovered that it was not allied to it, but conftituted a diftinct fpecies, belonging to the calc genus.

An analyfis of Klaproth, which was made fome time afterwards, fhewed that it was a compound of lime and phofphoric acid.

3. Hauy confiders it to be identical with appatite' and Karften arranges it a fubfpecies *.

* Karftens Tabellen.

SIXTEENTH SPECIES.

Boracite.

Borazit.—*Werner.*

Boracite, *Wid.* s. 533. *Id. Kirw.* vol. 1. p. 172. *Id. Estner*, b. 2. s. 1061. *Id. Emm.* b. 1. s. 509, *Id. Nap.* p. 370.—La boracite, *Broch.* t. 1. p. 589.

External Characters.

Its colours are yellowish, smoke and greyish white; also greenish white, which passes into asparagus green.

It is always crystallized, and the following are its principal figures:

1. Cube having its edges and angles truncated.
2. When the truncations on the edges increase so much that the original planes nearly disappear, the garnet dodecaedron is nearly formed.
3. When the truncations on the angles increase so much that the original faces of the cube disappear an octaedron is formed.

Some varieties approach in figure to the crystallization of the hyacinth.

Crystals

Cryſtals always ſmooth and ſplendent; and are middle-ſized and ſmall.

Internally its luſtre is ſhining which approaches to gliſtening, and is intermediate between adamantine and vitreous.

Fracture intermediate between imperfectly and ſmall conchoidal, and fine grained uneven.

Fragments indeterminately angular, not particularly ſharp-edged.

Commonly ſemitranſparent, ſeldom paſſes into tranſparent.

Semi-hard in a high degree, equal to that of fluor ſpar.

Brittle.

Eaſily frangible.

Not particularly heavy.

Specific gravity—According to *Weſtrumb*, 2,566,

Chemical Character.

It melts without addition before the blow pipe.

Constituent

Constituent Parts.

Lime	11,0
Silica	2,0
Alumina	1,0
Magnefia	13,5
Oxyd of Iron	0,7
Boracic acid	68,0

Weftrumb. Naturfors. Freund. t. b.

Geographic and Geognostic Situation.

It has hitherto been found only imbedded in gyps, and but in one place, that is in the upper part of the hill of Kalkberg near Lüneburg in Hanover.

Obfervations.

1. Lazius who difcovered it, named it cubic quartz, and Weftrumb, who firft analyzed it, boracic fpar.

2. Hauy finds that by heating it affords pofitive and negative electricity. An account of his experiments is to be found in his tracts.

SEVENTEENTH SPECIES.

Fluor.

Fluſs.—*Werner.*

This ſpecies is by Werner divided into two ſub-ſpecies, 1. Compact fluor. 2, Fluor ſpar.

FIRST SUBSPECIES.

Compact Fluor.

Dichter Flufs.—*Werner.*

Fluor folidus, *Wall.* t. 1. p. 542? — Dichter flus, *Wid.* f. 542.—Compact fluor, *Kirw.* vol. 1. p. 127.—Dichter flufs, *Eſtner*, b. 2. f. 1067. *Id. Emm.* b. 1. f. 516.—Fluorite compatta, *Nap.* p. 374.—Le fluor compacte, *Broch.* t. 1. p. 594.

External Characters.

Its colours are greyifh white, and greenifh grey, fometimes alfo inclining a little to blue, and of various degrees of intenfity.

Sometimes marked with yellowifh and reddifh brown fpots.

Occurs maffi. e.

Externally dull or feebly glimmering.

Internally glimmering and vitreous.

Fracture even, which in fome varieties approaches to imperfect and flat conchoidal, in others to fplintery.

Fragments

Fragments indeterminately angular, and more or lefs fharp-edged.

Tranflucent.

Semi-hard in a high degree.

Brittle.

Eafily frangible.

Not particularly heavy, approaching to heavy.

Geognostic and Geographic Situation.

It is found in veins accompanied with fluor fpar, at Stollberg in the Harz, but is very rare.

SECOND SUBSPECIES.

Fluor Spar.

Flufs Spath.—*Werner.*

Fluor fpathofus. Fluor granularis et fluor criftallifatus, *Wall.* t. 1. p. 180, 182 et 183.—Spath fufible ou vitreux, *R, d. L.* t. 2, p. 1.—Chaux fluorée, *D. B.* t. 1. p. 355. Flus fpath, *Wid.* f. 558.—Foliated or fparry fluor, *Kirw.* vol. 1. p. 127.—Flufs fpath, *Eftner*, b. 2. f. 1070. *Id.* *Emm.* b. 1. f. 519.—Fluorite lamellare, *Nap.* p. 375.—Fluor, *Lam.* t. 1. p. 78.—Chaux fluatée criftallifee, *Hauy*, t. 2. p. 247.—Le fpath-fluor, *Broch.* t. 1. p. 595.

External Characters.

It prefents a great variety of colours, as blue, green, yellow, white; alfo red and black, and feldom brown. From rofe red it paffes into reddifh and greyifh white, from this into fmoke grey and pearl grey, which latter variety paffes into violet blue, of various degrees of intenfity, and azure blue; from this into fmalt, Berlin, and fky blue; and further into verdegris, feladon, mountain, leek, emerald, grafs, olive, and piftacio green; and into a colour which is intermediate between grafs and emerald

green

green and greenifh white, which paffes into apple green. It occurs alfo wax and honey yellow, and dark yellowifh brown. The violet blue fometimes inclines to bluifh black.

Often feveral colours together, and they are arranged in fpotted, dotted, and ftriped colour delineations.

Maffive, diffeminated, and often alfo cryftallized. Its moft common figure is the cube, and to it all its other cryftalline forms can be traced. The following are the principal varieties of cryftallization:

1. Cube with truncated edges; when thefe truncating planes increafe fo much as to caufe the faces of the cube to difappear, the garnet dodecaedron is formed*.
2. Cube with truncated angles, when thefe planes increafe fo as to caufe the faces of the cube to difappear, an octaedron is formed†.
3. Cube with bevilled edges: when the bevilling planes enlarge fo much as to caufe the original faces of the cube to difappear, a teffular cryftal with 24 triangular planes is formed, or

* Of this rare variety there are feveral fine fpecimens in the poffeffion of the Hon. Mr Greville, and Brochant informs us that it has been found near Breuil, and in the neighbourhood of Chalons on the Saone in France.

† Beautiful fpecimens of this variety are found in Cornwall.

or it may be confidered as a cube having each plane divided into four*.

4. Cube having its angles acuminated by three planes, which are fet on the lateral planes.
5. Cube having its angles acuminated by fix planes, which are fet on the lateral planes.
6. Imperfect rhomb, with cylindrical convex lateral planes.

The cryftals are placed on one another, or fide by fide, and are from very large to very fmall.

Surface fmooth, fometimes drufy ; in the firft the luftre is fplendent, in the fecond glimmering ; the furface of the octaedron is rough.

Internally its luftre is fplendent, and in fome varieties paffes to fhining, and is vitreous, which inclines a little to pearly.

Fracture more or lefs perfectly foliated ; and prefents a fourfold equiangular cleavage, in the direction of the planes of an octaedron, or in that of a tetraedron.

Fragments tetrahedral, and fometimes octaedral.

More or lefs tranflucent, but the cryftals are femitranfparent and tranfparent.

Occurs in large, coarfe, and fmall grained diftinct concretions ; alfo in prifmatic diftinct concretions, which are interfected by curved and thin lamellar diftinct concretions.

* In the magnificent collection belonging to Sir John St Aubyn, there are fpecimens of this variety from Cornwall and Cumberland.—*Babington's Catalogue.*

Semi-

Semi-hard, but in a higher degree than calc ſpar.
Eaſily frangible.
Brittle.
Not particularly heavy.
Specific gravity.—From 3,100 to 3,200.

Chemical Characters.

Before the blow pipe it melts without addition into greyiſh white enamel; when laid on ignited coal, it exhibits a phoſphoric light; and when two fragments are rubbed againſt each other in the dark they become luminous.

Constituent Parts.

Lime	57
Fluoric acid	16
Water	27

According to *Scheele.*

Geognostic Situation.

Occurs principally in veins, but alſo in beds in the older primitive mountains. The venigenous is of different ages, as has been aſcertained by Werner; thus the oldeſt occurs along with tin, examples of which there are at Zinnwald in Bohemia; another is

is that which is accompanied with lead glance, and of which there are fine examples at the Halſbrucke, near Freyberg, and in Derbyſhire; and a third and very diſtinct formation is that which is found along with copper pyrites in the Harz.

Geographic Situation.

It is found in Saxony; Harz; France; England, in Derbyſhire, Cornwall and Cumberland; in Scotland it is extremely rare, the only localities I am acquainted with are Aberdeenſhire and the Shetland iſlands; alſo, according to Brochant, beautiful roſe coloured octaedral fluor is found at Chamouni in Savoy. In Hungary, the Bannat, and Tranſilvania it is rare.

Uſe.

It is much employed as a flux of certain ores of copper, ſilver and iron. When its colours are good, and the maſs of conſiderable magnitude, it is cut into ornaments of various ſizes, which are often highly valued. The acid which it contains has been alſo employed in the way of experiment for etching on glaſs.

Obſervation.

Obſervations.

Although this very intereſting foſſil has been mentioned as a product of many different countries, we know but little either of the formations which it conſtitutes, or of which it forms but a part; and, excepting the geognoſtic ſituations which have been determined by Werner, and a few of his ſcholars, we meet with little or nothing in mineralogical writers but a mere liſt of localities. This is much to be regretted, particularly when we conſider, that an acquaintance with the geognoſtic ſituation and formations of individual foſſils, not only aſſiſts us very much in aſcertaining their true nature, but is highly intereſting in regard to the natural hiſtory of the globe. We muſt not, therefore, reſt ſatisfied with the mere deſcription, local ſituation, and the uſual vague geognoſtic characters of a foſſil, but muſt endeavour to aſcertain not only the rock formation in which it occurs, but alſo its repoſitory, (that is, whether it occurs in ſtrata, beds, rock maſſes, veins, or kidneys), the age of this repoſitory in regard of all others, and its general and peculiar characters.

EIGHTEENTH SPECIES.

Gyps.

This ſpecies comprehends four ſubſpecies, 1. Gyps earth. 2. Compact gyps. 3. Foliated gyps. 4. Fibrous gyps.

FIRST SUBSPECIES.

Gyps earth.

Gipferde.—*Werner.*

Gypfum terreftre farinaceum. Farina foffilis, *Wall.* t. 1. p. 36.—Gypferde, *Wid.* p. 543.—Farinaceous gypfum, *Kirw.* vol. 1. p. 120.—Gypferde, *Eftner*, b. 2. f. 1095.—*Id. Emm.* b. 1. f. 527.—Geffo terrofo, *Nap* p. 379.—Le gypfe terreux, *Broch.* t. 1. p. 601.

External Characters.

Colour yellowifh white, which paffes into yellowifh grey, and fometimes nearly into fnow white.

Intermediate between very fine fcaly and dufty.

Dull and feebly glimmering.

Soils a little.

Feels meagre and a little rough, but foft and fine.

Light.

Geognostic Situation.

Occurs rarely; found in wet feafons in gyps countries where, according to Werner, it is found in fimilar fituations, and is formed in the fame manner as rock milk.

Geographic Situation.

It is found near Zella and Apitz in the circle of Newftadt in Voightland. Brochant informs us that it has been alfo found at Mont Martre near Paris.

Ufe.

Like other fubfpecies of gyps it is employed as a manure.

Obfervation.

It is diftinguifhed from rock milk by its colour, luftre, and fcaly particles.

SECOND SUBSPECIES.

Compact Gyps.

Dichter Gips.—*Werner.*

Gypfum alabaftrum et gypfum æquabile, *Wall.* t. 1. p. 161, 162 —Dichter gyps, *Wid.* f. 544.—Compact gypfum, *Kirw.* vol. 1. p. 121.—Dichter gyps, *Eftner*, b. 2. f. 1098.—*Id. Emm.* b. 1. f. 529.—Geffo compatto alabaftro, *Nap.* p. 384.—Alabaftrite, *Lam.* t. 2. p. 76.—Chaux fulphatie compacte, *Hauy.* t. 2. p. 266.—Le gypfe compacte, *Broch.* t. 1. p. 602.

External Characters.

It occurs almoft always afh grey, paffing into fmoke grey, alfo yellowifh grey.

Maffive.

Internally commonly dull, fometimes very faintly glimmering.

Fracture even, paffing into very fine fplintery.

Fragments indeterminately angular, pretty blunt edged.

Feebly tranflucent on the edges.

Very ſoft.
Rather mild.
Not particularly eaſily frangible.
Not particularly heavy, lighter than limeſtone.
Specific gravity—1,300.

Uſe.

It is employed in architecture and ſculpture, under the name, Alabaſter.

It occurs along with foliated gyps.

THIRD SUBSPECIES.

Foliated Gyps.

Blættriger Gyps.—*Werner.*

Gypſum lamellare, *Wall.* t. 1. p. 165.—Blættriger gyps, *Wid.* ſ. 548. — Granularly foliated gypſum, *Kirw.* vol. 1. p. 123.—Blættriger gips, *Eſtner.* b. 2. ſ. 1109. *Id. Emm.* b. 1. ſ. 532.—Geſſo lamellare, *Nap.* p. 381. Le gyps lamelleux, *Broch.* t. 1. p. 606.

External Characters.

It is commonly white, grey, and red, ſeldomer yellow, brown, and black. Of white it preſents the following varieties: ſnow, greyiſh, yellowiſh, and reddiſh white; from reddiſh white it paſſes into fleſh red, blood red, and brick red; the greyiſh white paſſes into aſh grey and ſmoke grey, and greyiſh black; the yellowiſh grey paſſes into wax yellow. It occurs very ſeldom hair brown, and this only when it is intermixed with ſtink-ſtone.

It preſents ſpotted, ſtriped, and veined colour delineations.

It

It occurs maſſive, alſo in blunt edged pieces, that approach to the roundiſh. Seldom cryſtalliſed and when it is ſo, the cryſtals are conical lenſes imbedded in clay.

Internally its luſtre alternates from ſhining and gliſtening to glimmering, and is intermediate between pearly and vitreous.

Fracture nearly perfect and rather curved foliated, with a ſingle cleavage. Some varieties ſhew a ſhort and broad ſcopiformly and ſtellularly diverging radiated fracture.

Fragments indeterminately angular and blunt edged.

The maſſive occurs in coarſe, ſmall, and fine grained diſtinct concretions, even ſometimes paſſing into compact. The radiated occurs in priſmatic diſtinct concretions.

Tranſlucent, and duplicating, according to Hauy.

Very ſoft.

Rather mild.

Not particularly difficultly frangible.

Light, paſſing into not particularly heavy.

Obſervations.

This ſpecies has been confounded with granular limeſtone, to which indeed it bears a ſtrong reſemblance; but its blunt edged fragments and ſoftneſs, independent of other characters, diſtinguiſh it ſufficiently from granular limeſtone.

FOURTH

FOURTH SUBSPECIES.

Fibrous Gyps.

Fafriger Gips.—*Werner.*

Gypfum ftriatum, *Wall.* t. 1. p. 167.—Fafriger gyps, *Wid.* f. 546.—Fibrous gypfum, *Kirw.* vol. 1. p. 122—Faf-riger gips, *Eftner.* b. 1. f. 1105. *Id. Emm,* b. 1. f. 536. —Geffo fibrofo, *Nap.* p. 386—Chaux fulphatie fibreux, *Hauy.* t. 2. p. 266.—Le gypfe fibreux, *Broch.* t. 1. p. 604.

External Characters.

Its principal colours are white, grey, and red; of white it prefents the following varieties: yellowifh, greyifh, fnow, and reddifh white. From reddifh white it paffes into flefh red, and light hyacinth red; the yellowifh white paffes into yellowifh grey; of grey the only variety is afh grey. All the colours in this fubfpecies are paler than in the preceding fubfpecies.

Occurs maffive and dentiform; the latter is longitudinally ftreaked.

Internal

Internal luſtre moſtly gliſtening, yet ſometimes paſſes into ſhining and ſplendent; and is pearly.

Fracture parallely fibrous, paſſing from delicately fibrous to broad fibrous, bordering on radiated, and generally ſomewhat curved. There is a particular variety which has a double fracture, in it the croſs fracture is fibrous, and the longitudinal foliated.

Fragments moſtly ſplintery.

Commonly ſemi-tranſparent and tranſlucent; the variety with double fracture ſemi-tranſparent.

Very ſoft.

Rather mild.

Not particularly brittle.

Eaſily frangible.

Not particularly heavy.

Chemical Character.

When expoſed to the flame of a blow pipe it becomes opaque, and is changed into a white enamel, which in twenty-four hours falls into powder. *Lelievre.* When pure it produces no efferveſcence with acids.

Geognostic Situation of Gyps.

The foſſils belonging to this ſpecies, according to Werner, conſtitute three very diſtinct formations; and, from the late obſervations of Von Buch, probably a fourth may be added.

It

It is not improbable that when we become acquainted with the gyps formation of Mont Martre, it will prove to be much newer than the third gyps formation, even younger than the neweſt flötz trap.

The oldeſt gyps occurs in primitive mountains; the ſecond or the oldeſt floetz gyps lies over the oldeſt floetz limeſtone, and is accompanied with rock ſalt and ſtink-ſtone; the third or newer gyps lies over the ſecond or variegated ſandſtone formation, and under the ſecond floetz limeſtone. The fibrous gyps occurs in, and is characteriſtic of, the third formation, as the foliated is of the ſecond.

The formation diſcovered by Von Buch appears to lie in tranſition rocks, ſo that, if it ſhall be confirmed, it muſt be placed between the primitive and floetz formations.

Geographic Situation.

The oldeſt formation has only been diſcovered in one place, that is, near to Bellinzona, in the Alps of Italian Switzerland. The tranſition gyps of Von Buch occurs in the valley of Leogang, in the county of Salzbourg; the two floetz formations are found in abundance in the province of Thuringia.

In England, it occurs in Derbyſhire, but to what formation the gyps of that county belongs we know not, as no well educated geognoſt has ever communicated any obſervations regarding it. It occurs alſo in conſiderable quantity in Cumberland, and of theſe, as far as I am able to judge, that which occurs in the

 neighbourhood

neighbourhood of Carlisle, appears to belong to the old floetz formation. Near the village of Moffat, in the county of Dumfries in Scotland, fragments of gyps are found imbedded in a conglomerate, which reposes on transition rocks; but to what formation it belongs, or if it is accidental, has not been determined.

Use.

When deprived of its water of crystallization by burning, and then powdered and mixed with determinate portions of water, it forms an excellent cement; it is also used for many ornamental purposes, the detail of which belongs to œconomical mineralogy.

Observations.

It is worthy of remark that gyps frequently contains other fossils imbedded, as quartz, boracite, arragone, and native sulphur.

NINETEENTH SPECIES.

Selenite.

Fraueneis.—*Werner.*

Gypfum felenites, *Wall.* t. 1. p. 165.—Selenite, *R. d. L.* t. 1. p. 441.—Fraueneis, *Wern. Cronft.* f. 53.—Broad foliated gypfum, *Kirw.* vol. 1. p. 123.—Fraueneis, *Emm.* b. 1. f. 540.—Chaux fulphatée cryftalifeè, *Hauy.* t. 2. p. 266.—La felenite, *Broch.* t. 1. p. 609.

External Characters.

Its principal colour is fnow white, which paffes into yellowifh and greyifh white; from greyifh white it paffes into fmoke grey, and feldom into afh grey; from yellowifh white it paffes into wax, honey, and ochre yellow, and into yellowifh brown; but this latter colour is produced by an intermixture with ftinkftone. Is moft generally maffive, and not unfrequently cryftallifed as follows:

1. Pretty oblique fix-fided prifm, having two oppofite planes larger, and four oppofite fmaller, and rather flatly bevilled on both extremities, the bevilling planes fet oblique-

 ly,

ly, yet parallely on the broader lateral planes, ſo that it has a rhomboidal aſpect; when very ſhort it paſſes into the rhomb.

2. The ſame priſm accuminated at both extremities by four planes, which are ſet on the lateral edges that bound the two larger planes.

3. Twin cryſtals which are formed by the incorporation of two of the preceding cryſtals, in the direction of their breadth, in ſuch a manner that the united ſummits at one extremity form a re-entering angle, but at the other a four-planed acumination.

4. Sometimes the priſms, 1. 2. are terminated by ſpherical convex planes. If the priſm diſappears, and theſe planes come together, a ſpherical convex lens is formed.

The lens is often columnarly aggregated.

The broader lateral planes are ſmooth, the others are longitudinally ſtreaked and ſhining. The planes of the lens are dull and rough.

Cryſtals are ſeldom large, generally middle ſized.

Internally its luſtre is ſhining and ſplendent, and is pearly.

Fracture is perfectly foliated, moſtly ſtraight, often curved, with one perfect and two imperfect cleavages; the two latter interſect the former obliqueangularly, and they are interſected rectangularly by the firſt or perfect cleavage, and this arrangement gives riſe to rhomboidal fragments.

the

Maſſive varieties are ſometimes unſeparated, ſometimes ſhew large, coarſe, ſmall, and fine grained concretions. Surface of the concretions is generally very uneven.

Completely tranſparent.

Very ſoft.

Very mild.

A little commonly flexible.

Eaſily ſplit in the direction of the principal fracture.

Not particularly eaſily frangible.

Not particularly heavy approaching to light.

Specific gravity—2,322.

Constituent Parts.

Lime	50
Sulphuric acid	47
Water	21
	600

According to *Bergman.*

Geognostic Situation.

It is found in the oldeſt gyps formation, and in ſingle cryſtals, in clay beds in the neweſt formations; ſometimes in veins in primitive mountains, of which Werner mentions two inſtances, in his tranſlation of Cronſted, one at Herrengrunde near

near Newſol, where it occurs in veins of copper pyrites and fahl ore; the other at Tetſchen in Bohemia, in a vein of lead glance.

Geographic Situation.

It is found in Thuringia, at Mont Martre near Paris; England, as in Oxfordſhire, Iſle of Sheppy, &c.

Uſes.

On account of its purity it is employed in taking the moſt delicate impreſſions; alſo for crayons, and, when burnt and powdered, it is uſed for cleanſing ſilver.

TWENTIETH SPECIES.

Cube Spar.

Wurfelfpath.—*Werner.*

Muriacite, *Klaproth*.—Anhydrous fulphat of lime, *Hauy*, t. 4. p. 348.

External Characters.

Its colour is milk white, which fometimes paffes into greyifh white, yellowifh white, and reddifh white; which latter approaches to pearl grey.

Maffive.

Luftre fhining, paffing into fplendent, and perfectly pearly.

Fracture perfectly foliated, prefenting a three-fold rectangular cleavage.

Fragments cubical.

Occurs in large, coarfe, and fmall grained diftinct concretions; alfo in broad prifmatic and thin and ftreight and rather longifh lamellar diftinct concretions.

Tranflucent.

Tranflucent.
Soft *.
Uncommonly eafily frangible.
Not particularly heavy.
Specific gravity—2,964, *Hauy.*

Conftituent Parts.

According to Klaproth, who names it muriacite, it contains 0,15 fea falt, 0,27 gyps, and 0,28 of fand and lime. Vauquelin has analized a foffil faid to be the fame, but found no fea falt nor water of cryftallization, whence he names it anhydrous fulphat of lime.

Geognostic and Geographic Situation.

It is found in falt rocks in the archbifhopric of Salzbourg.

* Scratches calcfpar, and more ftrongly gyps. *Hauy.*

SEVENTH GENUS.

BARYTE GENUS.

FIRST SPECIES.

Witherite.

Witherit.—*Werner*.

Baryt aerée *De Born*. t. 1. p. 267.—Witherite, *Wid*. s. 554. —Barolite, *Kirw*. vol. 1. p. 134.—Luft or Kohlensaurer Baryt, *Estner*, b. 2. s. 1124.—Witerite, *Nap*. p. 387. *Id*. *Lam*. t. 2. p. 20.—Baryte carbonatée, *Hauy*, t. 2. p. 309.—La Witherite *Broch*, t. 1. p. 613.

External Characters.

Commonly light yellowish grey, passing into a middle colour between yellowish white, and greyish white.

Most commonly massive, but sometimes also crystallised in

1. Six-ſided priſms acuminated by ſix planes which are ſet on the lateral planes.
2. The ſame priſm, in which the edges that ſeperate the lateral and acuminating planes are truncated.
3. Double ſix-ſided pyramids.

Luſtre of the principal fracture is ſhining, croſs fracture gliſtening and reſinous.

Principal fracture is intermediate between floriformly foliated, and narrow and ſcopiformly diverging radiated, and approaches ſometimes more to the one, ſometimes more to the other. It appears to poſſeſs ſeveral cleavages; croſs fracture is fine grained uneven, paſſing into ſplintery.

Fragments generally wedge ſhaped.

Maſſive varieties are compoſed of indiſtinct wedge-ſhaped, priſmatic diſtinct concretions, that often paſs into large and coarſe grained diſtinct concretions, which are very much grown together.

Tranſlucent, paſſing into ſemi-tranſparent.

Soft, and ſemi hard.

Brittle.

Eaſily frangible.

Heavy, approaching to not particularly heavy, lighter than heavy ſpar.

Specific gravity—4,300 to 4,338.

Chemical Characters.

It melts without addition before the blow pipe into a white enamel. It diſſolves with effervefcence in acids. Paper when dipped in a ſolution of nitrate of baryte exhibits, on burning, a yellow flame; but when immerſed in ſolution of nitrate of ſtrontian, a purple flame.

Conſtituent Parts.

Carbonat of baryte	98,246		
Carbonat of ſtrontian	1,703		
Alumina with iron	0,43		
Carbonat of copper	0,8		
Barytes		62	74,5
Carbonic acid		22	25,5
Water		16	
	100	100	100,0
	Klaproth. b. 2. p. 86.	*Pelletier.*	*Vauquelin. Hauy.* Min. t. 2 p. 309.

Geognostic Situation.

According to the obſervations of Mr Watt, jun. a ſcholar of Werner, it occurs in veins along with heavy

heavy ſpar, lead glance, blende and calamine; theſe veins traverſe the independent coal formation.

Geographic Situatiou.

It is found at Angleſark in Lancaſhire; other localities have been mentioned, but they are doubtful.

Uſe.

It is a very active poiſon, but its combination with muriatic acid, when uſed with caution, has been found ſerviceable in ſcrophula.

SECOND SPECIES.

Heavy Spar or Baryte*.

Schwer Spath.—*Werner.*

This ſpecies is by Werner divided into eight ſub-ſpecies, viz. 1. Heavy ſpar earth. 2. Compact heavy ſpar. 3. Granular heavy ſpar. 4. Curved lamellar heavy ſpar. 5. Straight lamellar heavy ſpar. 6. Columnar heavy ſpar. 7. Priſmatic heavy ſpar. 8. Bolognefe ſpar.

* The term Baryte has been univerſally adopted by chemiſts; the Engliſh denomination, Heavy Spar, is, however, for many reaſons, to be preferred.

FIRST

FIRST SUBSPECIES

Heavy-ſpar Earth.

Schwerſpath Erde.—*Werner.*

Baryte vitriolée terreuſe, *De Born*, t. 1. p. 268.—Schwerſpath erde, *Wid.* ſ. 558.—Earthy baroſelenite, *Kirw.* vol. 1. p. 138.—Schwerſpath erde, *Eſtner*, b 2 ſ. 1143. *Id. Emm.* b. 1. ſ. 550.—Baryt-vitriolata terrea, *Nap.* p. 402.—Le ſpath peſant terreux, *Broch.* t. 1. p. 617.

External Characters.

Its colours are reddiſh and yellowiſh white.

It conſiſts of glimmering, and generally coarſe earthy particles, that are intermediate between duſty and ſcaly, and ſometimes rather angular.

Occurs maſſive.

Does not ſoil.

Sometimes looſe, ſometimes more or leſs cohering, or of friable conſiſtence.

Feels rough and coarſe, meagre and ſomewhat ſharp.

Not particularly heavy, approaching to heavy.

Geognoſtic

Geognostic and Geographic Situations.

Occurs in drufy cavities in veins of heavy fpar. It has been found in one of the levels of the mine called Krieg and Frieden near Freyberg; alfo in the mines of Staffordfhire and Derbyfhire in England. Other localities are mentioned, but on doubtful authority.

Obfervations.

1. It is well diftinguifhed from all other earthy minerals by its greater fpecific gravity.

2. It has been fuppofed to be compact heavy fpar difintegrated, but its occurrence in clofe cavities appears on the contrary to fhew that it is an original powdery depofit.

SECOND SUBSPECIES.

Compact Heavy Spar.

Dichter Schwerspath.—*Werner*.

Baryte vi,riolata compacte, *De Born*. t. 1. p. 268.—Dichter schwerspath, *Wid*. s. 559.—Compact baroselenite, *Kirw.* vol. 1. p. 138. — Dichter schwerspath, *Estner*, b. 2. s. 1146. *Id. Emm.* b. 1. s 552.—Barite vitriolata compatta, *Nap*. p. 400.—Le spath pesant compacte, *Broch* t. 1. p. 618.

External Characters.

Its colour is yellowish white, which passes into greyish white.

Occurs massive, and with fine drusy cubic and reniform impressions.

Lustre glimmering, when passing into the following species glistening.

Fracture coarse earthy, passing into fine grained uneven; sometimes it is indistinctly granularly foliated.

Fragments indeterminately angular, rather blunt-edged.

Occurs

Occurs ſometimes in thick and curved lamellar diſtinct concretions.

Opaque, ſometimes tranſlucent on the edges.

Very ſoft, and ſoft.

Rather mild.

Not particularly brittle.

Eaſily frangible.

Feels meagre.

Heavy.

Geognostic Situation.

Found in metalliferous veins.

Geographic Situation.

Found in mines in the Freyberg mining field; alſo in the mines of Staffordſhire and Derbyſhire, where it is known under the name Cawk. Mr Servoz, according to Brochant, is ſaid to have found in clay ſlate near to Servos in Savoy.

Obſervation.

In the mines of Freyberg we can obſerve on one hand the tranſition from this ſpecies into earthy heavy ſpar, on the other into foliated heavy ſpar.

THIRD SUBSPECIES.

Granular Heavy Spar.

Körniger ſchwerſpath.—*Werner.*

Le ſpath peſant grenue, *Broch.* t. 1. p. 620.

External Characters.

Colour ſometimes ſnow white, ſometimes milk white, which paſſes into dark ſmoke grey.

Occurs always maſſive.

Internally its luſtre is between gliſtening and glimmering, and is pearly.

Fracture ſmall and fine foliated, and ſeems to paſs into ſplintery.

Fragments indeterminately angular and blunt edged.

It preſents fine, ſeldom ſmall grained diſtinct concretions; they are ſometimes ſo minute as no longer to be viſible, when it paſſes to ſplintery.

Feebly tranſlucent.

Soft.

Not particularly brittle.

Eaſily

Eafily frangible.
Heavy.

Geognostic and Geographic Situations.

It is found in beds along with galena, at Peggau in Stiria; alfo in the mining field of Freyberg, and at Schlangenberg in Siberia, where it is accompanied with copper green and native copper.

Obfervations.

1. It bears a ftriking refemblance to granular limeftone, from which, however, it is diftinguifhed by the following characters:

1. It has lefs luftre.
2. When the diftinct concretions are of the fame fize as in granular limeftone, they are not fo well defined.
3. It is fofter, and
4. It is much heavier.

2. The greater or lefs fingular diftinctnefs of the concretions, affords, to an experienced eye, a good mark by which to diftinguifh granular limeftone, granular heavy fpar, and granular gyps from one another; thus in granular limeftone they are well defined, in granular heavy fpar lefs fo, and in granular gyps ftill more indiftinct.

The bluntneſs of the fragments can alſo, by an experienced eye, be uſed for diſtinguiſhing theſe ſpecies from one another.

FOURTH SUBSPECIES.

Curved lamellar Heavy Spar.

Krumm-ſchaaliger Schwerſpath.—*Werner.*

Le ſpath peſant teſtacé courbe, ou le ſpath lamelleux, *Broch.* t. 1. p. 621.

External Characters.

Its principal colours are white, grey and red. Of white the following varieties occur:—yellowiſh, greyiſh, and reddiſh white. Of grey it preſents yellowiſh ſmoke, and pearl grey. From pearl grey it paſſes into fleſh red and blood red; the yellowiſh grey paſſes into yellowiſh brown*.

* The yellowiſh brown variety occurs only in England.

Sometimes

Sometimes ſeveral colours occur together, and are diſtributed in broad ſtriped delineations.

Occurs moſt commonly maſſive, frequently reniform, alſo globular and with impreſſions; alſo in ſmall lenſes and four-ſided tables, which have always a druſy ſurface.

Internally its luſtre is gliſtening paſſing into ſhining, and is intermediate between pearly and reſinous.

Fracture generally curved foliated, and ſome ſpecimens paſs into ſplintery, (the latter has the leaſt luſtre), even into ſcopiformly diverging radiated; this has moſt luſtre.

Fragments generally indeterminately angular, blunt edged.

It is commonly compoſed, particularly the reniform, of curved and thick lamellar diſtinct concretions, which are bent in the direction of the external ſurface, and according to which the colour is arranged.

More or leſs tranſlucent.

Soft, in a low degree.

Eaſily frangible.

Heavy.

For its geognoſtic and geographic ſituations ſee the following ſubſpecies.

FIFTH SUBSPECIES.

Straight lamellar Heavy Spar.

Geradſchaaliger ſchwerſpath.—*Werner.*

This ſpecies is by Werner divided into two kinds, *a*. Freſh ſtraight lamellar Heavy Spar. *b*. Diſintegrated ſtraight lamellar Heavy Spar.

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a. Freſh ſtraight lamellar Heavy Spar.

Friſcher geradſchaaliger ſchwerſpath.—*Werner.*

External Characters.

Its moſt common colours are white and red. Of white it preſents the following varieties :—milk, yellowiſh and reddiſh white. Of red, fleſh, blood and browniſh

brownifh red. It occurs alfo greyifh black, but that is a very rare variety.

The preceding are the colours of the maffive; the cryftallized poffeffes befides thefe, grey, yellow, green and brown. The following are the varieties of each colour that occurs:—grey, yellowifh and greenifh grey; green, olive, and oil green; yellow, wax, honey and wine yellow, and yellowifh brown, which approaches to liver brown; alfo of a middle colour between fmalt blue and bluifh grey, which approaches to indigo blue.

The colours are light and fomewhat muddy.

The red colour occurs very feldom in the cryftallized varieties.

It is moft frequently maffive, but alfo very often cryftallized; the two radical cryftallizations are

1. Oblique four-fided table.
2. Rectangular four-fided table.

1. *Oblique four-fided table.*

a. Perfect.

b. The obtufe terminal edges truncated; when thefe become large, a fix-fided table is formed.

c. All the angles truncated; when thefe truncating planes increafe until they meet, bevillments are formed. The bevillments on the obtufe terminal edges are fometimes very deep, and a fecond time bevilled, and the

fecond

ſecond bevillment twice broken; ſometimes the edges of the obtuſe, and more rarely the edges of the acute bevillment, are truncated.

d. By the increaſe of the bevillment on all the terminal edges, the tranſition is made into the rectangular table, bevilled on the terminal planes.

2. *Rectangular four-ſided table.*

a. Perfect.

b. All the terminal planes bevilled, and the ſtill remaining part of the planes form truncations on the angles; when theſe truncations increaſe, the four-ſided paſſes into

c. An eight-ſided table, which preſents the following varieties :—

α. Truncated on all its lateral edges.

β. Having all its terminal planes bevilled, and the edges of the bevillments truncated.

γ. The bevilments in *c.* are ſometimes rounded off, and thus a kind of lens is formed.

The planes of the cryſtals are ſmooth, generally ſplendent and pearly.

Internally its luſtre is ſhining, which ſometimes approaches to ſplendent, ſometimes to gliſtening, and is commonly intermediate between pearly and vitreous.

Fracture

Fracture more or lefs perfectly ftraight foliated, having a perfect and a little obliquely interfecting three-fold cleavage.

Fragments rhomboidal, approaching to cubical.

Occurs in diftinct concretions, which are ftraight lamellar, and are from thin to very thick; they are thicker at one extremity than another, hence they are rather wedge-fhaped, and their crofs fracture exhibits a fcopiformly diverging afpect.

The maffive varieties are tranflucent, the cryftallized tranfparent and femitranfparent, and is duplicating.

Soft, fcratches calc fpar, but is fcratched by fluor fpar.

Not particularly brittle.

Eafily frangible.

Heavy.

Specific gravity.—4,300 to 4,500.

Chemical Characters.

It melts without addition before the blow pipe into a folid white enamel, and when pure does not effervefce with acids.

Constituent Parts.

Barytes	84	67,2
Sulphuric acid	13	32,8
Water	0,3	
	Bergman.	*Withering.*

Klaproth found in ſeveral varieties of heavy ſpar, ſmall portions of ſulphate of ſtrontian, ſilica, oxyd of iron, and alumina.

Geognostic Situation.

Occurs almoſt always in veins, ſeldom in beds. In primitive mountains it is found in conſiderable quantity, but is more abundant in the tranſition rocks. It occurs in beds and veins in the floetz formations, and continues even to the neweſt floetz trap, where it lines druſes, and forms veins.

Geographic Situation.

Beſides Saxony, it occurs in Hungary, Bohemia, the Harz; England; Scotland, Leadhills, Wanlockhead, the rocks belonging to the floetz trap formation in the vicinity of Edinburgh, and iſland of Arran, where it probably occurs in beds.

b. Diſintegrated

b. Difintegrated Heavy Spar.

Mulmicher oder Mürber geradfchaaliger Schwerfpath.—*Werner.*

External Characters.

Its colours are greyifh, yellowifh, and reddifh white.
Generally maffive.
Luftre fhining, paffing into gliftening.
Fracture and diftinct concretions the fame as in the preceding kind, but lefs diftinct.
Faintly tranflucent on the edges, or nearly opaque.
Soft, paffing into very foft.
Not particularly brittle.
Very eafily frangible.
Heavy.

SIXTH SUBSPECIES.

Columnar Heavy Spar.

Stangenſpath.—*Werner*.

Id. Emm. b. 1. ſ. 569.—Le ſpath peſant en barres, *Broch.* t. 1. p. 631.

External Characters.

Its colour is yellowiſh, milk, greyiſh, and greeniſh white.

Is always cryſtalliſed in acicular oblique four-ſided priſms, which are columnarly aggregated, and interſect one another.

Externally and internally it is ſhining, paſſing to ſplendent, and perfectly pearly.

Fracture ſtraight foliated, with a three-fold cleavage.

Fragments rhomboidal.

It probably alſo occurs in granular diſtinct concretions.

Tranſlucent.

Soft.

Not

Not particularly brittle.
Eafily frangible.
Heavy.

Geognostic and Geographic Situation.

It is found in metallic veins, accompanied by fluor fpar, quartz, and other fubfpecies of heavy fpar. It was formerly found in cönfiderable quantity in the vein of Lorenzgegen Trum near Freyberg ; is found in the mines of Scharfenberg near Meiffen, and in thofe in the vicinity of Marienberg. It is alfo found in Derbyfhire.

Obfervations.

It has been by fome confounded with fchorl, by others with white lead ore. To fchorl it has no refemblance, but it might be confounded with white lead ore. It is however eafily diftinguifhed from it by the following characters : white lead ore has an adamantine luftre, its fracture is fmall conchoidal, and its fpecific gravity is 6,5585 ; on the contrary, columnar heavy fpar has a pearly luftre, fracture is foliated, and its fpecific gravity is not above 4,500.

SEVENTH SUBSPECIES.

Prifmatic Heavy Spar.

Saulen Schwerfpath.—*Werner.*

External Characters.

Its colours are greenifh grey, yellowifh grey, afh grey, fmoke grey, and pearl grey; the pearl grey paffes into flefh red; it occurs alfo pale indigo blue.

The flefh red colour is very rare.

Occurs maffive, but moft commonly cryftallifed. The following are its cryftalline figures.

1. Oblique four-fided prifm acutely bevilled on both extremities, the bevilling planes fet on the acute lateral edges. Sometimes one of the bevilling planes is fo large as to caufe the other to difappear.
2. Oblique four-fided prifm acuminated by four planes, which are fet on the lateral edges. This figure is produced by the deep truncation of the extremities of the obtufe lateral edges.
3. When the bevilling planes approach to each other by the prifm becoming fhorter, the lengthened octaedron is formed.

4. The

4. The two oppoſite obtuſe lateral edges are ſometimes truncated, and thus a ſix-ſided priſm is formed

Cryſtals are middle ſized and ſmall, form druſes, and interſect one another.

Luſtre is ſhining and ſplendent, and reſinous, or pearly?

Fracture is lamellar or foliated, with a three-fold cleavage like lamellar heavy ſpar.

It occurs in coarſe and ſmall grained diſtinct concretions, and this diſtinguiſhes it from lamellar heavy ſpar.

Generally tranſlucent, cryſtals are often tranſparent.

Soft.

Not particularly brittle.

Uncommonly eaſily frangible, more ſo than lamellar heavy ſpar.

In other characters the ſame as the preceding ſubſpecies.

Geographic Situation.

Found in mineral veins in Saxony.

Obſervation.

It was formerly confounded with lamellar heavy ſpar.

EIGHTH

EIGHTH SUSBPECIES.

Bolognefe Spar.

Bolognefer Spath.—*Werner.*

Gypfum fpathofum opacum femipellucidum, *Wall.* t. 1. p. 169 —Var. of blættriger fchwerfpath, *Wid.* f. 561.—Bologneferftein, *Emm.* b. 4. f. 572.—Litheofphore, *Lam.* t. 2. p. 24.—Baryte fulphatée rayonnée, *Hauy*, t. 2. p. 302.—Le fpath de Bologne ou la pierre de Bologne, *Broch.* t. 1. p. 633.

External Characters.

Its colour is fmoke grey, which paffes into afh grey and yellowifh grey.

It occurs in roundifh and blunt edged flatly compreffed pieces, having an uneven furface; fome pieces have even the fpheroidal fhape of the lens; others exhibit traces of a low three fided pyramid.

Internally its luftre is fometimes fhining, fometimes gliftening and refinous.

Fracture is parallely, ftellularly, and fcopiformly diverging radiated; fometimes alfo foliated in certain directions

directions, resembling in this particular the fracture of Arragone.

Fragments are sometimes wedge shaped, sometimes indeterminately angular.

Sometimes occurs in large grained distinct concretions, in which the rays in each concretion have a different direction; sometimes the concretions are wedge shaped, and even pass into unseparated.

Strongly translucent.

In other characters it agrees with the preceding subspecies.

Geognostic and Geographic Situations.

Werner informs us that it is found imbedded in clay and marle rocks at Monte Paterno, near Bologna in Italy; the unequal surface of the roundest masses, which are found loose, shew, as Werner well observes, that they have not received their rounded form from attrition, but owe it to their imbedment.

EIGHTH GENUS.

STRONTIANE GENUS.

FIRST SPECIES.

Strontiane.

Stronthian.—*Werner.*

Id. Wid. ſ. 571. *Id. Kirw.* vol. 1. p. 332. *Id. Eſtner,* b. 2. ſ. 48.—Kohlenſaurer ſtrontianit, or ſtrontiane carbonatée, *Emm.* b. 3. ſ. 310.—Strontianite, *Nap.* p. 391. —Strontites, *Hope, Edin. Tranſ.* vol. 1. *Id. Lam.* t. 2. p. 130.—Strontiane carbonatée, *Hauy,* t. 2. p. 327.—La ſtrontianite, *Broch.* t. 1. p. 637.

External Characters.

Its moſt common colour is intermediate between aſparagus and apple green, often alſo greeniſh white. Sometimes both colours occur together in the ſame ſpecimen.

It

It occurs moſt commonly maſſive, and ſometimes cryſtalliſed in acicular cryſtals, that appear to be ſix-ſided priſms pretty flatly acuminated by ſix planes.

The cryſtals are ſcopiformly and manipularly aggregated.

The luſtre of its principal fracture is ſhining and gliſtening, croſs fracture gliſtening, and is pearly.

Principal fracture narrow, ſtraight, and ſcopiformly diverging radiated; towards the centre of the radiation it appears always white.

Croſs fracture is fine grained uneven.

It is ſtill uncertain whether or not it occurs in diſtinct concretions; perhaps it may ſhew a tendency to wedge ſhaped concretions.

Tranſlucent in a greater or leſſer degree.

Soft and ſemi-hard.

Brittle.

Eaſily frangible.

Not particularly heavy, approaching to heavy.

Specific gravity—3,675, *Klaproth.*—3,400 to 3,644, *Kirwan.*

Chemical Characters.

Before the blow pipe, without addition, it becomes white, but does not melt, and if afterwards expoſed to the air it falls into powder. It has not the ſame

poifonous properties with Witherite. It difolves in acids with effervefcence. If we dip a piece of paper into a folution of nitrate of ftrontian and allow it to dry and then inflame it, it burns with a very beautiful carmine red colour. *Brochant.*

Constituent Parts.

Strontiane	61,21	69,5	62,0
Carbonic acid	30,20	30,0	30,0
Water	8,50	0,5	8,0
	100,0	100,0	100,0
According to	*Hope,*	*Klaproth,*	*Pelletier.*

Geognostic and Geographic Situations.

It has been hitherto found only at Strontian in Argylefhire, where it occurs along with lead glance, heavy fpar, calc fpar, and iron pyrites, in a vein that traverfes gneifs *.

* The kind of rock may ftill remain doubtful, as the authority of the foreign mineralogift who firft announced it is not of the higheft kind.

Obfervations.

Observations.

Dr Hope, in his masterly memoir published in the Edinburgh Philosophical Transactions for 1790, first made us acquainted with the peculiar earth which this genus contains. It afterwards engaged the attention of other able chemists, particularly Kirwan, Klaproth, Pelletier, and Vauquelin.

SECOND SPECIES.

Celeſtine.

Celeſtin.—*Werner*.

Schwefel ſaurer ſtrontianit, *Eſtner*, b. 2. ſ. 1185. *Id. Emm.* b. 3. ſ. 312—Strontiane ſulphatée, *Hauy*, t. 2. p. 327. La celeſtine, *Broch.* t. 1. p. 640.

This ſpecies is by Werner divided into two ſub-ſpecies. 1. Fibrous Celeſtine. 2. Foliated Celeſtine.

FIRST SUBSPECIES.

Fibrous Celeſtine.

Faſriger Celeſtine.—*Werner.*

External Characters.

Its colour is intermediate between indigo blue and bluiſh grey, and ſometimes paſſes into milk white; ſaid alſo to occur pale ſky blue. It loſes its colour in keeping, even if very carefully preſerved.

It occurs maſſive and in plates, alſo cryſtalliſed.

Luſtre of the longitudinal fracture ſhining, croſs fracture gliſtening and pearly, or between pearly and reſinous.

The longitudinal fracture is foliated, but this is ſeldom to be obſerved, as it does not break eaſily in that direction. Croſs fracture parallel, coarſe, and rather curved fibrous.

Fragments ſplintery.

It ſhews a tendency to priſmatic diſtinct concretions, which appear to be parallel and conformable with the fibrous fracture.

Tranſlucent.

From ſoft to ſemi-hard.
Eaſily frangible.
Heavy, but not in a high degree.
Specific gravity—3,830, *Klaproth*.

Geognostic and Geographic Situation.

Its geognoſtic ſituation is very imperfectly known, it is ſuſpected to occur in marle. It is found at Frankſtown in Pennſylvania, and alſo at Bouvron near Toul in France, according to Brochant.

SECOND SUBSPECIES.

Foliated Celeftine.

Blättriger Celeftin.—*Werner*.

External Characters.

Its colour is milk white, which falls into blue.

It occurs maffive, and is cryftallifed in fix-fided tables that interfect one another.

Luftre gliftening, approaching to fhining.

Fracture imperfectly foliated, with a two-fold cleavage, perhaps a three-fold cleavage.

Fragments indeterminately angular.

Occurs in thin and ftraight, generally a little curved lamellar loofely aggregated concretions, which are collected into large granular concretions.

Strongly tranflucent, the cryftals rarely tranfparent.

Soft, approaching to femi-hard.

Not particularly brittle.

Eafily frangible.

Heavy.

Geognostic Situation.

Sometimes occurs in fulphur beds. *Vide Nat. Journal.*

Geographic Situation.

Is found very finely cryftallifed in Sicily; alfo in the South of England, near Briftol.

Obfervations.

1. Celeftine has been alfo found cryftallifed in
   - *a.* Oblique four-fided prifms having fometimes alternately broader and narrower lateral planes, and acuminated by four planes which are fet on the lateral edges, and which terminate in a line which is in the direction of the acuter lateral edges.
   - *b.* Sometimes the acuter lateral edges, and the edges formed by the meeting of the acuminating planes are truncated.

Thefe cryftallizations belong to a fubfpecies that may be denominated radiated celeftine, and which differs from the foliated in cryftallization, aggregation of cryftals, fracture, and diftinct concretions.

2. There is found, imbedded in clay, in the gyps quarries of Mont Martre near Paris, a compact fubfpecies

pecies of celeſtine, of which Brochant gives us the following deſcription :—Colour bluiſh grey. Occurs maſſive. Fracture ſplintery. Opaque. Semi-hard, paſſing to ſoft. Somewhat frangible. Rather mild. Specific gravity 3,500.

The ſpecimens in my collection poſſeſs the following characters:

Colour yellowiſh grey. Occurs in flattened ſpheroidal and kidney ſhaped pieces; which are often internally traverſed by rents, that divide its ſurface into quadrangular pieces: the ſurfaces of theſe pieces are druſy. Fracture fine ſplintery, and ſometimes minute foliated. Opaque, and ſometimes tranſlucent on the edges. Soft, paſſing into ſemi-hard. Eaſily frangible. Mild. Heavy. Specific gravity 3,596. Conſtituent parts, according to *Vauquelin* *J. d. M.* n. 53. p. 355.

Sulphat of ſtrontiane	91,42
Carbonate of lime	8,33
Oxyd of iron	0,25

Celeſtine may thus be divided into four ſubſpecies. 1. Compact. 2. Fibrous. 3. Radiated. 4. Foliated.

END OF THE FIRST VOLUME.

[illegible]

found in solution, if not [illegible] The chief [illegible] are the following: [illegible] —[illegible]. [illegible] [illegible] Fibrous [illegible] [illegible] [illegible] Salt. [illegible]

The specimens in my collection yield the following reactions :

Colour white or grey ; Crystals or Fibrous [illegible] and having many [illegible] in[illegible] [illegible] the [illegible] of the [illegible] [illegible] on the edges. Soft, [illegible] Specific gravity [illegible] Constituent parts, according to [illegible]

[illegible]

[illegible]

[illegible]

[illegible] may be [illegible]

[illegible]

[illegible]

EXPLANATION

OF THE

PLATES.

I AM indebted to Count de Bournon and Abbé Hauy, two of the moſt able and diſtinguiſhed cryſtallographers of the preſent age, for the greater number of the figures that accompany this work. I intended to have completed the cryſtal ſuites of ſeveral of the ſpecies that are ſtill imperfect, but want of leiſure and opportunity has prevented me.

DIAMOND.

Fig. 1. Octaedron.

Fig. 2. Octaedron, in which each plane is divided into ſix, ſo that the figure has 48 triangular faces*.

* We hope Count de Bournon will ſoon gratify the mineralogical public with an account of the highly intereſting ſuite of diamonds, which are in the collection of the Hon. Mr. Greville.

ZIRCON.

ZIRCON.

Fig. 3. Rectangular four-fided prifm, acuminated by four planes, which are fet on the lateral planes.

Fig. 4. Same figure, in which the angles formed by the meeting of the acuminating and lateral planes are bevilled.

Fig. 5. Same figure as the preceding, in which the terminal edges are truncated.

HYACINTH.

Fig. 6. Rectangular four-fided prifm, acuminated by four planes, which are fet on the lateral edges.

CHRYSOBERYLL.

Fig. 7. Flat, double fix-fided pyramid, in which the fummits of the acuminations are truncated.

Fig. 8. Longifh, thick fix-fided table.

CHRYSOLITE.

Fig. 9. Defcribed in No. 1. and 2. p. 42 and 43.

AUGITE.

Fig. 10. Six-fided prifm, with two broader and four fmaller lateral planes, bevilled on both extremities, and the bevilling planes fet on obliquely but parallely on thofe lateral edges, which are formed by the fmaller lateral planes.

Fig. 11. Differs from the preceding in having the edges formed by the meeting of the fmaller lateral planes truncated.

VESUVIANE.

Fig. 12. Rectangular four-fided prifm, truncated on the lateral and terminal edges.

13. Same figure, acuminated by four planes, which are fet on the lateral planes, and the extremities of the acuminations pretty deeply truncated.

GARNET.

Fig. 14. Garnet dodecaedron.

Fig. 15. Garnet dodecaedron, having all its edges deeply truncated; it is the intermediate cryftal between the dodecaedron and the following figure.

Fig. 16. Which is a double eight-fided pyramid, acuminated by four planes.

Fig. 17. Preceding figure, in which the truncations mark its progrefs to the garnet dodecaedron; and the acuminations its progrefs from the garnet dodecaedron.

GRENATITE.

Fig. 18. As defcribed at page 76.

SPINELLE.

Fig. 19. Octaedron. Fig. 20. Lengthened octaedron. Fig 21. Acute rhomboid. Fig. 22. Preceding figure truncated. Fig. 23, Tetraedron. Fig. 24. Tetraedron, truncated on the angles. Fig. 25. Octaedron, having its common bafis truncated. Fig, 26. Rectangular four-fided prifm, acuminated by four planes, placed on the lateral planes. Fig. 27. Octaedron, having all its edges truncated. Fig. 28. Garnet dodecaedron, having the remains of the faces of the octaedron. Fig. 29. Garnet dodecaedron. Fig. 30. Octaedron, having each of its angles acuminated by four planes which are fet on the lateral planes. Fig. 31. Same figure as the preceding, having the edges truncated. Fig. 32. Twin cryftal.

SAPPHIRE.

Fig. 33. Double, three-fided pyramid. Fig. 34. Extremities of the pyramid deeply truncated. Fig. 35. Very deeply truncated. Fig. 36. Six-fided table. Fig. 37. Common bafis of the pyramid truncated. Fig. 38. Six-fided prifm, acuminated by three planes, which are placed on the alternate lateral edges, and the extremities of the acuminations flightly truncated. Fig. 39. Preceding figure, having its acuminations fo deeply truncated that the remains of the truncating planes appear like truncations on the alternate angles. Fig. 40. Six-fided prifm. Fig. 41. Six-fided table. Fig. 42. Six-fided prifm, truncated on the edges and angles. Fig. 43. Preceding figure, only truncated on the terminal edges. Fig. 44. Six-fided prifm, acuminated by fix planes, fet on the lateral planes, and the extremity of the acumination truncated. Fig. 45. Double fix-fided pyramid. Fig. 46. Same figure, with its extremities truncated. Fig. 47. Same more deeply truncated. Fig. 48. Same figure, in which the alternate angles, formed by the meeting of the truncating plane and the acuminating planes are truncated. Fig. 49. Acute, fingle fix-fided pyramid, having its lateral edges truncated. Fig. 50. Single fix-fided pyramid. Fig. 51. Single fix-fided pyramid, in which the alternate and alternating angles are flightly truncated. Fig. 52. Acute fix-fided pyramid, flatly acuminated by three planes, which are fet on the alternate lateral edges.

PRECIOUS BERYLL.

Fig. 53. Six-fided prifm, with truncated lateral edges. Fig. 54. Same figure, with truncated angles. Fig. 55. Six-fided prifm, acuminated by fix planes, which are placed on the lateral planes, and the extremities

tremities of the acuminations deeply truncated. Fig. 56. Six-fided prifm, having terminal edges and angles truncated.

TOURMALINE.

Fig. 57. Equiangular three-fided prifm, acuminated on both extremities by three planes, which on one extremity are fet on the lateral planes, on the other on the lateral edges; and the lateral edges are fo deeply bevilled, that it appears like a nine-fided prifm. Fig. 58 Flat, double three-fided pyramid, in which the alternate angles, the common bafis, and all the edges, are truncated.

THUMERSTONE.

Fig. 59. Very oblique rhomb, in which the two oppofite obtufe lateral edges are truncated.

ROCK CRYSTAL.

Fig. 60. Equiangular fix-fided prifm, fomewhat acutely acuminated on both extremities by fix planes, which are fet on the lateral planes. Fig. 61. Double fix-fided pyramid.

PREHNITE.

Fig. 62. Oblique four fided table. Fig. 63. Same figure, truncated on the acute edges. Fig. 64. Flat four-fided prifm, bevilled on both extremities, the bevilling planes fet on the fmaller lateral planes, and the edge of the bevillment truncated.

RADIATED ZEOLITE.

Fig. 65. Broad rectangular four-fided prifm, acutely acuminated by four planes, which are fet on the lateral edges, and the extremities of the acuminations flightly truncated.

Fig. 66. Four-ſided priſm, flatly acuminated by four planes which are ſet on the lateral planes.

FOLIATED ZEOLITE.

Fig. 67. Short and oblique four-ſided priſm, in which the acute edges, and angles on the obtuſe edges are truncated. Fig. 68. Six-ſided priſm, truncated on all its angles.

CUBIC ZEOLITE.

Fig. 69. Cube. Fig. 70. Cube, acuminated on each of its angles by three planes, which are ſet on the lateral planes. Fig. 71. Acute double eight-ſided pyramid, acuminated on each extremity by four planes, which are placed on the alternate and alternating lateral edges.

CROSS STONE.

Fig. 72. Broad rectangular four-ſided priſm, acuminated by four planes, which are ſet on the lateral edges.

Fig. 73. Twin cryſtal, formed by the interſection of two of the preceding.

FELSPAR.

Fig. 74. Broad ſix-ſided priſm, bevilled on both extremities, the bevilling planes ſet on the edges formed by the meeting of the ſmaller lateral planes.

Fig. 75. Very oblique four-ſided priſm, flatly bevilled on both extremities, the bevilling planes ſet on the obtuſe lateral edges.

MICA.

Fig. 76. Equilateral ſix-ſided table.

BASALTIC

BASALTIC HORNBLENDE.

Fig. 77. Equilateral fix-fided prifm, acuminated on both extremities by three planes which on one extremity are fet on the lateral edges, on the other on the lateral planes. Fig. 78. Six-fided prifm, flatly acuminated on one extremity by four planes which are fet on the lateral planes, on the other bevilled, the bevilling planes fet on the two oppofite lateral edges. Fig. 79. Six-fided prifm, on one extremity flatly acuminated by three planes which are fet on the lateral edges, on the other bevilled, the bevilling planes fet on the two oppofite edges.

CALC SPAR.

1. *Six-sided Pyramid.*

Fig. 80. Double fix-fided pyramid, in which the lateral planes of the one are obliquely fet on the lateral planes of the other, in fuch a manner that the edges of the common bafis form a zig-zag line, and the more obtufe lateral edges of the one are oppofed to the lefs obtufe lateral edges of the other pyramid.

Fig. 81. Preceding figure, acuminated by three planes, which are placed on the alternate and obtufe lateral edges.

Fig. 82. Acute, double, fix-fided pyramid, acutely acuminated, and the acuminating planes fet on the alternate and lefs obtufe lateral edges.

Fig. 83. is fig. 80. whofe extremities are very deeply truncated, and the engles on the common bafis alfo truncated. Fig. 84. Preceding figure, in which the truncations of the angles of the bafis have increafed fo much that it forms the paffage to the next figure.

2. *Six-sided Prism.*

Fig. 85. Six ſided priſm, acuminated by ſix planes, which are ſet on the lateral edges. Fig. 86 Preceding figure, in which the acumination is again acuminated by three planes which are ſet on the alternate edges. Fig. 87. Six-ſided priſm, rather flatly acuminated by three planes, which are placed on the alternate lateral edges. Fig. 88 Perfect ſix-ſided priſm. Fig. 89. Preceding figure, truncated on the lateral edges.

3. *Three-sided Pyramid.*

Fig. 90. Obtuſe, double three-ſided pyramid, in which the lateral planes of the one are ſet on the lateral edges of the other. Fig. 91. Preceding figure, in which the lateral edges are truncated. Fig. 92. The extremities of the pyramids deeply truncated. Fig. 93. Acute double three-ſided pyramid. Fig. 94. The extremities of the preceding figure truncated. Fig. 95. Acute double three-ſided pyramid, ſlightly and acutely acuminated by three planes, which are ſet on the lateral edges. Fig. 96. Acute, double, three ſided pyramid, in which the lateral edges are bevilled. Fig. 97. Preceding figure, in which the edges of the bevillment are truncated.

APPATITE.

Fig. 98. Low, equiangular ſix ſided priſm. Fig. 99. Rather longer ſix-ſided priſm, with truncated lateral edges. Fig. 100. Six ſided priſm, with truncated terminal edges. Fig. 101. Six-ſided priſm, in which both terminal and lateral edges are truncated. Fig. 102. is fig. 100. in which the angles are truncated.

ASPARAGUS

ASPARAGUS or SPARGEL STONE.

Fig. 103. Equilateral fix-fided prifm, acuminated by fix planes, which are fet on the lateral planes. Fig. 104. Same figure as the preceding, but having the lateral edges truncated.

BORACITE.

Fig. 105. Cube, having its edges and angles truncated.

FLUOR SPAR.

Fig. 106. Cube. Fig. 107. Cube, with truncated edges. Fig. 108. Garnet dodecaedron. Fig. 109. Cube, deeply truncated on the angles, paffing to the following figure: Fig. 110. Octaedron. Fig. 111. Octaedron, truncated on the edges. Fig. 112. Cube, with bevilled edges. Fig. 113. Cube having each plane divided into four.

SELENITE.

Fig. 114. Pretty oblique fix-fided prifm, having two oppofite planes larger, and four oppofite fmaller, and rather flatly bevilled on both extremities, the bevilling planes fet obliquely, yet parallely on the broader lateral planes, fo that it has a rhomboidal afpect. Fig. 115. Rhomboidal cryftal. Fig. 116. is fig. 114. acuminated on both extremities by four planes which are fet on the lateral edges that bound the two larger planes.

STRAIGHT LAMELLAR HEAVY SPER.

Fig. 117. Oblique four-fided table, having its obtufe angles truncated. Fig 118. Six-fided table. Fig. 119. Rectangular four-fided table, having all its terminal planes bevilled. Fig. 120. Preceding figure, in which the angles are truncated.

PRISMATIC

PRISMATIC HEAVY SPAR.

Fig. 121. Oblique, four-fided prifm, bevilled on both extremities, the bevilling planes fet on the acute lateral edges.

CELESTINE.

Fig. 122. Oblique four-fided prifm, bevilled on both extremities, the bevilling planes fet on the acute lateral edges. Fig. 122. Preceding figure, truncated on the lateral edges. Fig. 123. Oblique four-fided prifm, acuminated by four planes, which are fet on the lateral edges, and the acuminating planes ending in a line. Fig. 124. Six-fided table.

PLATE II.

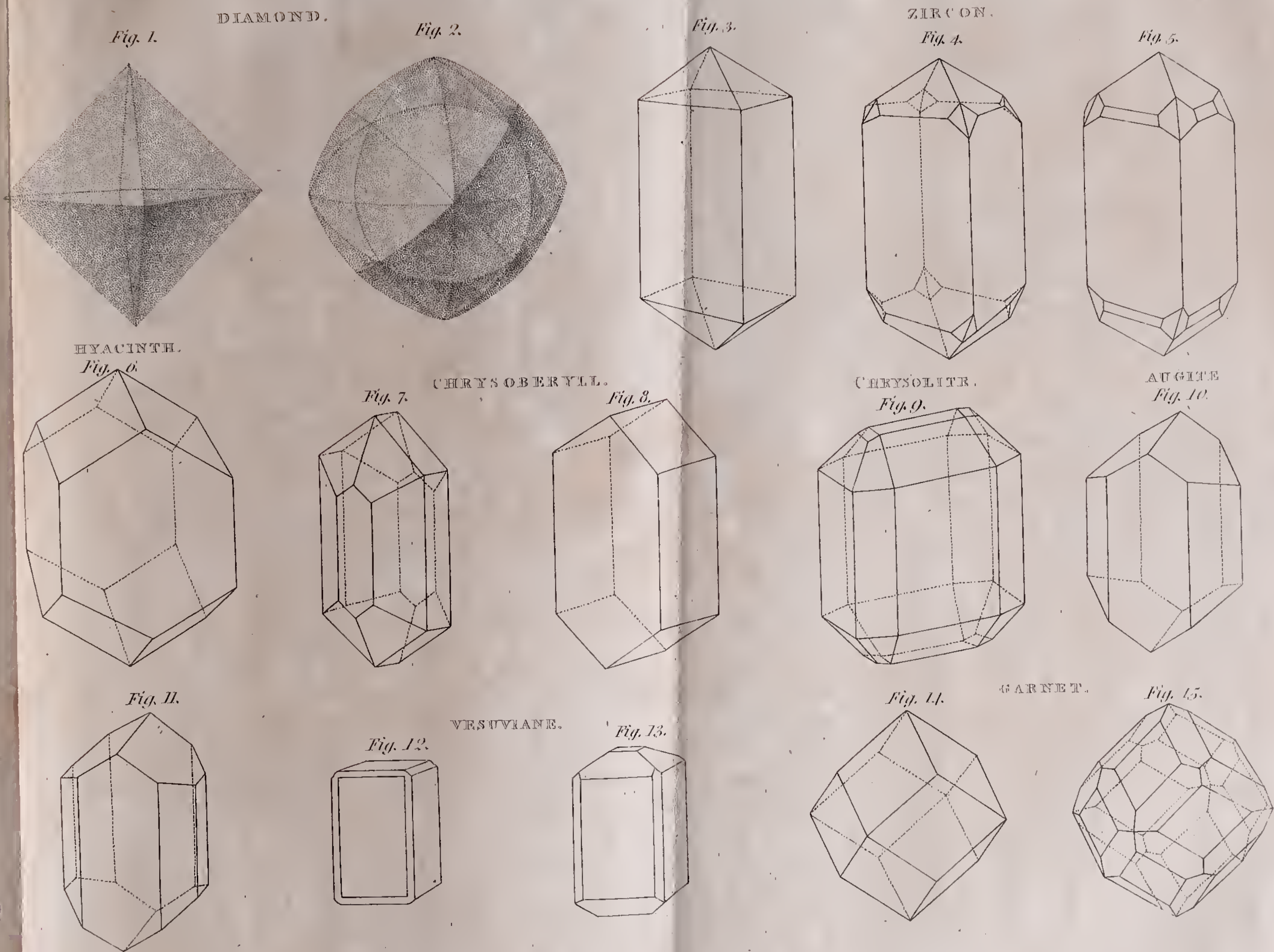
In giving an account of the cryftallizations of a mineral, we mention its fundamental figure or figures, defcribe their varieties, and arrange them according to their natural alliances. Colour, which is a very important character, muft alfo be treated in a fimilar manner; the fpecies and varieties muft be correctly determined, and arranged according to their affinities with each other, otherwife, particularly in minerals poffeffing extenfive fuites of colour, as diamond and fapphire, it would be very difficult to recollect them, and when remembered would not convey to the mind a very diftinct picture of this highly interefting character. I have, therefore, been careful in the defcriptions to determine the colours with precifion, and to arrange them as much as poffible in a natural order. In the treatife of Hauy, the colours are not arranged, and very feldom accurately determined; this is the cafe, although not in fo great a degree, with a more ufeful work, the Mineralogy of Brochant.

In

In plate 11. I have reprefented the colour fuite of diamond and fapphire, in which the numerous fpecies and varieties of colour are arranged according to their relations to each other. It would be ufeful to have fimilar plans of each fpecies.

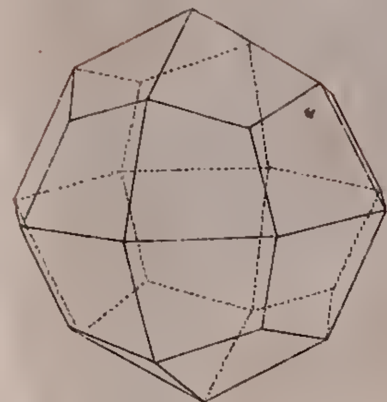
THE END.

PLATE I.


DIAMOND.
Fig. 1.
Fig. 2.
ZIRCON.
Fig. 3.
Fig. 4.
Fig. 5.
HYACINTH.
Fig. 6.
CHRYSOBERYLL.
Fig. 7.
Fig. 8.
CHRYSOLITE.
Fig. 9.
AUGITE
Fig. 10.
Fig. 11.
VESUVIANE.
Fig. 12.
Fig. 13.
GARNET.
Fig. 14.
Fig. 15.

GARNET. GRENATITE. SPINELLE. PLATE II

Fig. 16.



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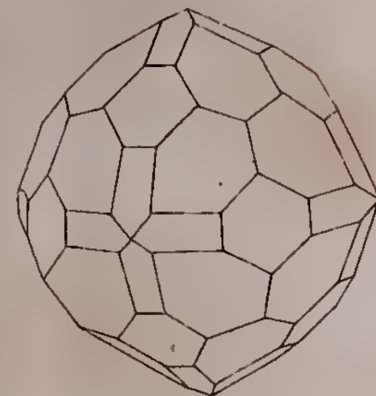
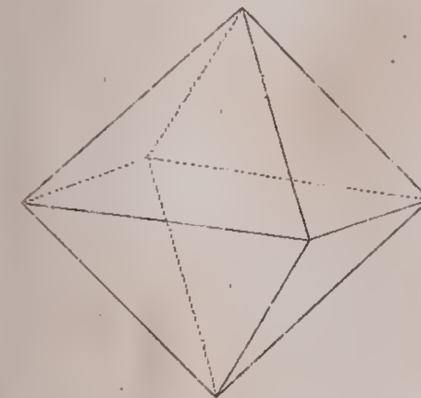


Fig. 18.

Fig. 19.



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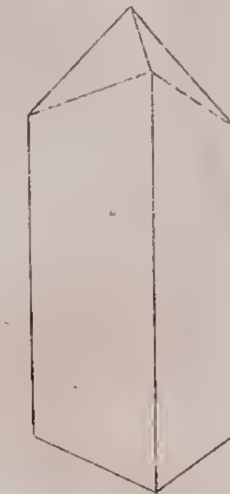

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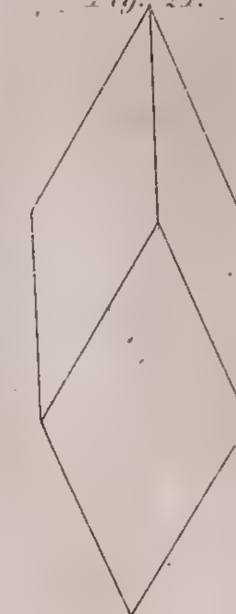

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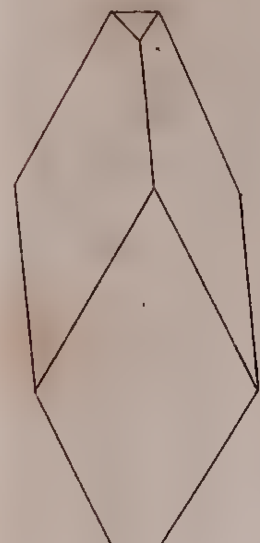

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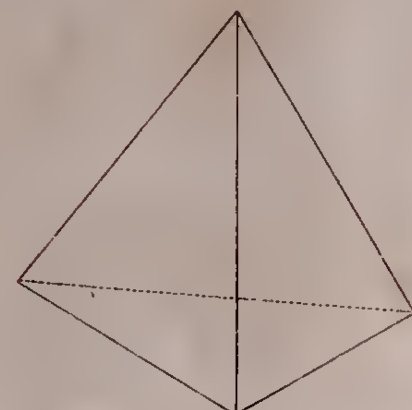
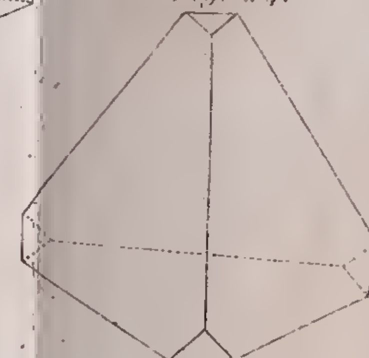


Fig. 24.



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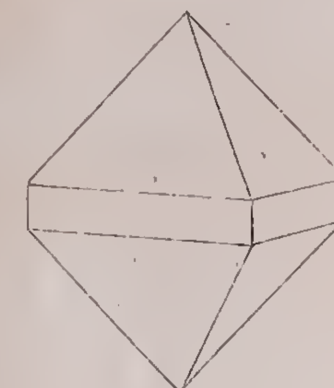

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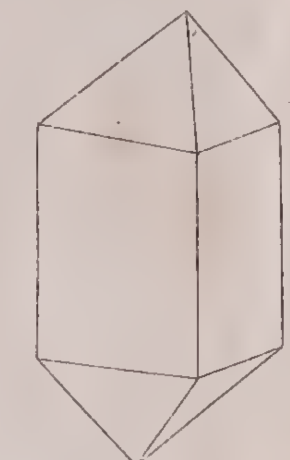

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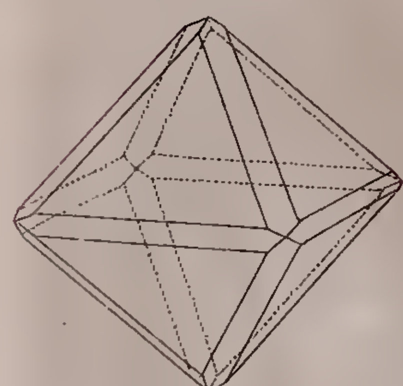

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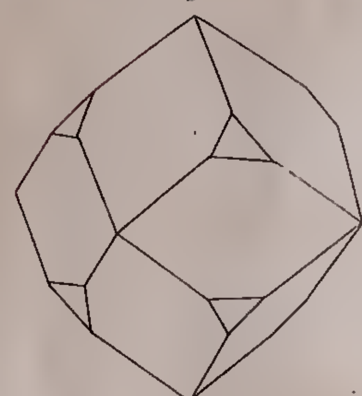
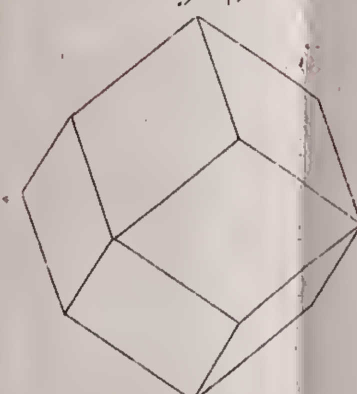


Fig. 29.



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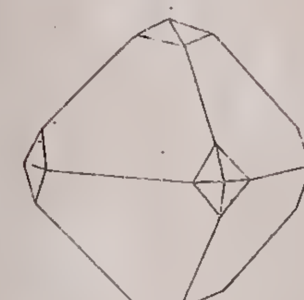

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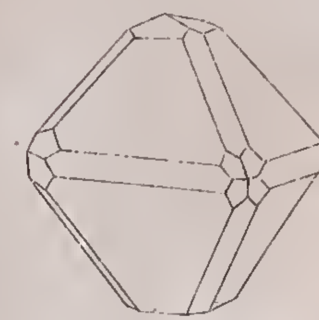


Fig. 32.

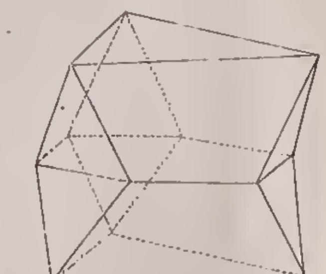


PLATE III.

SAPPHIRE.

Fig. 33.

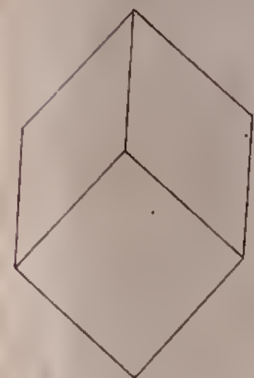


Fig. 34.

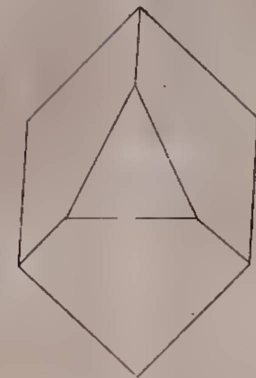


Fig. 35.

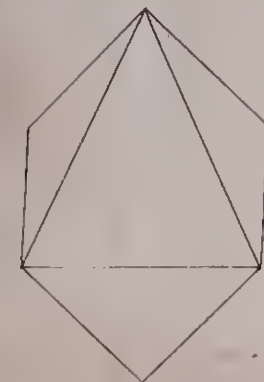


Fig. 36.

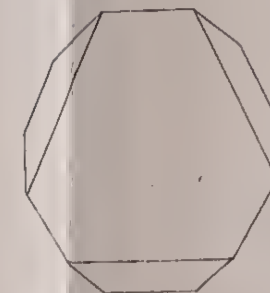


Fig. 37

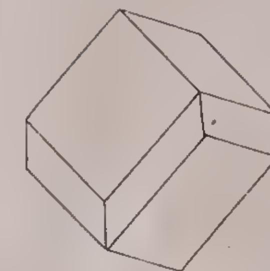
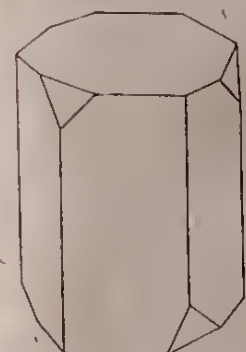


Fig. 38.

Fig. 39.



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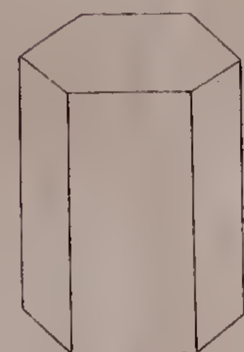
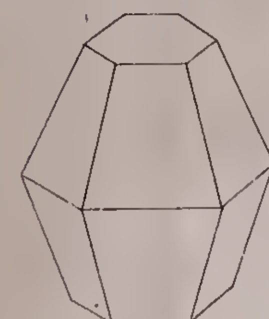


Fig. 41.

Fig. 47



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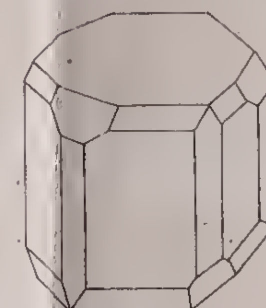
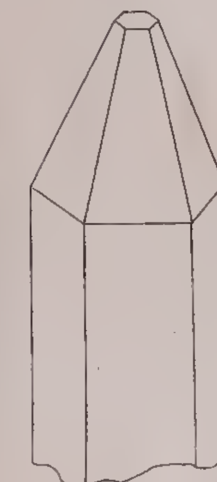


Fig. 43.

Fig. 44.



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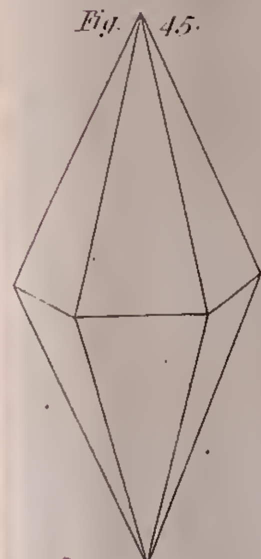

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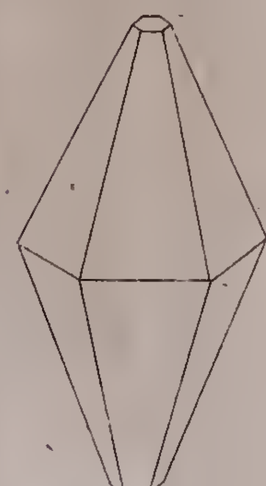

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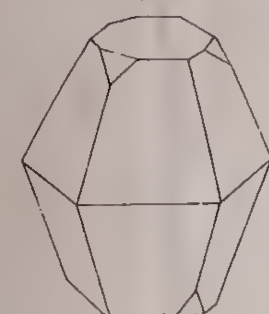
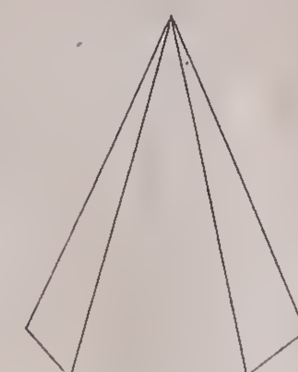


Fig. 49.

Fig. 50.



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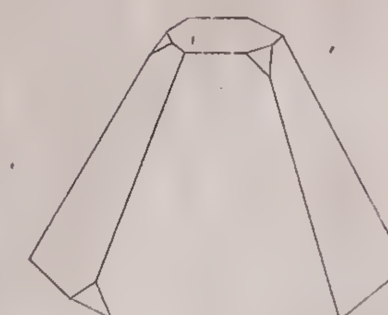


PRECIOUS BERYL.

Fig. 52.

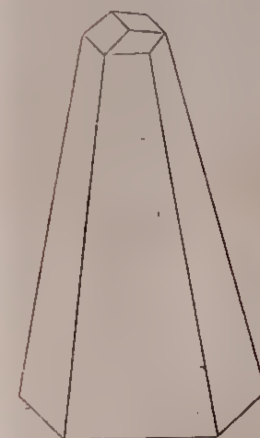
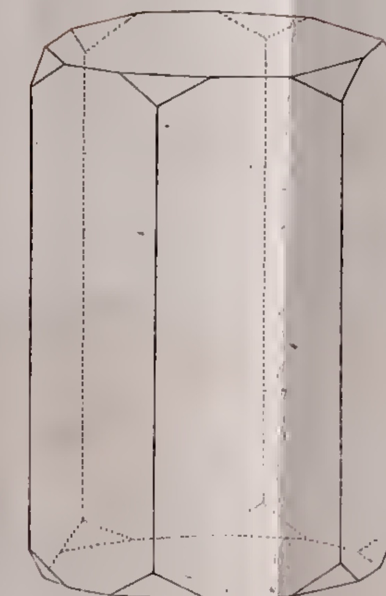


Fig. 53.

Fig. 54.



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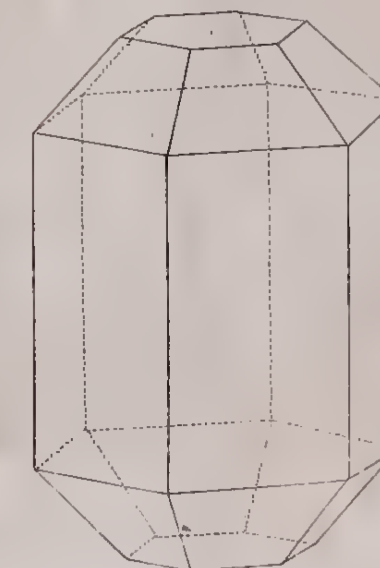

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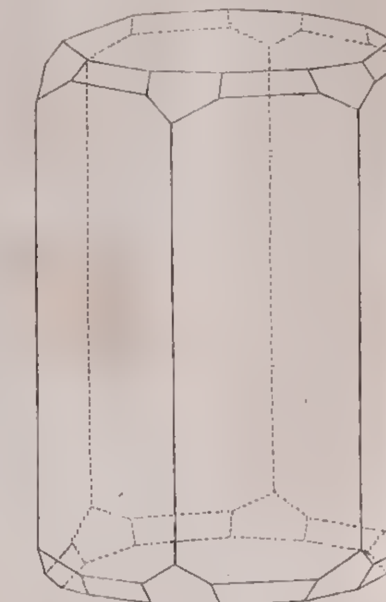
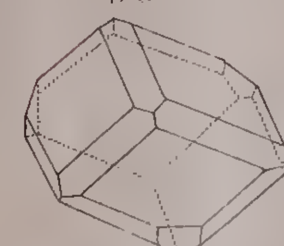


TOURMALINE.

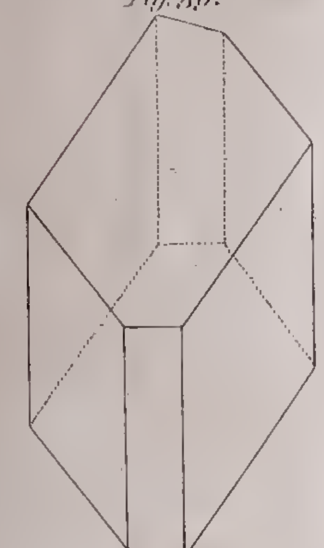
Fig. 57.

Fig. 58.



THUMERSTONE.

Fig. 59.



ROCK CRYSTAL.

Fig. 60.

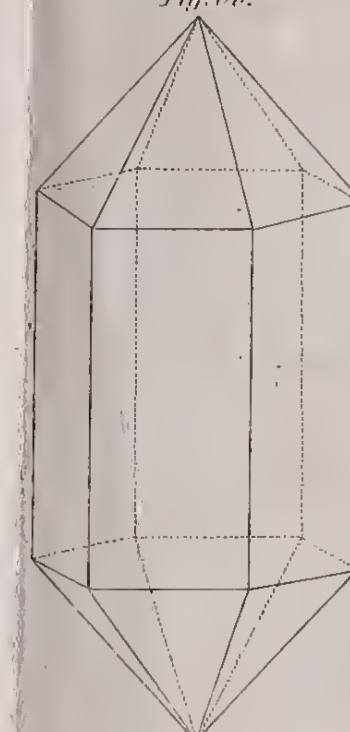


Fig. 61.

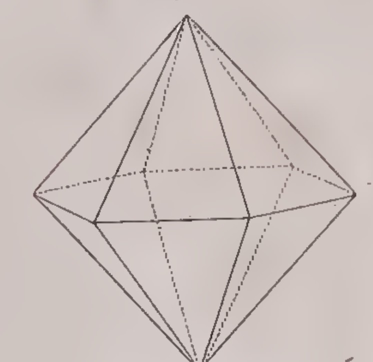
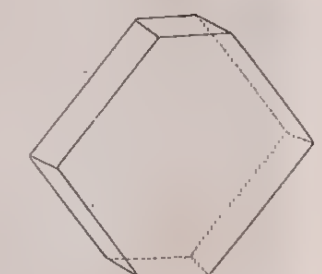


Fig. 63.



PREHNITE.

Fig. 62.

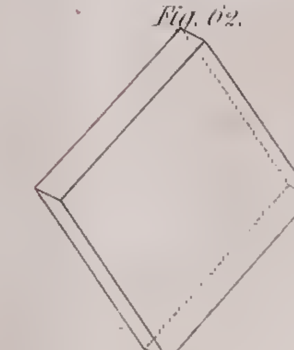
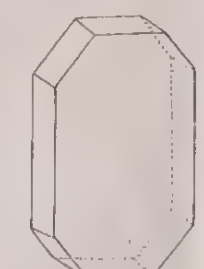


Fig. 64.



Radiated Zeolite.

Fig. 65.

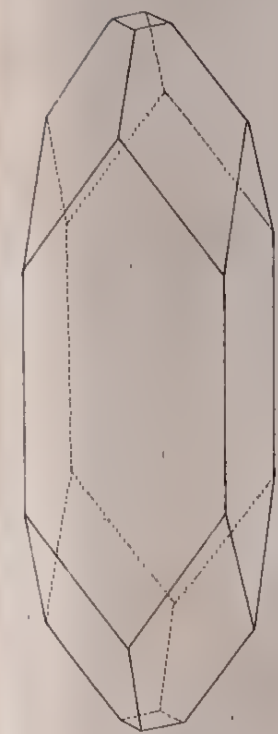
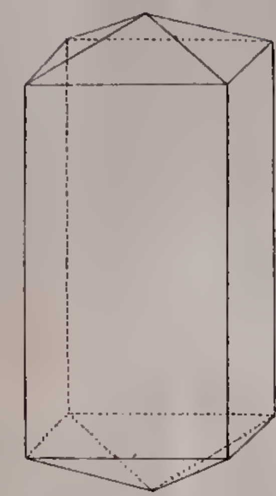


Fig. 66



Foliated Zeolite.

Fig. 67.

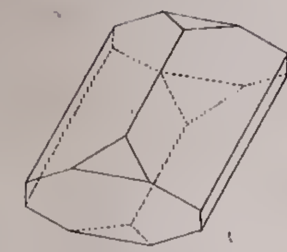
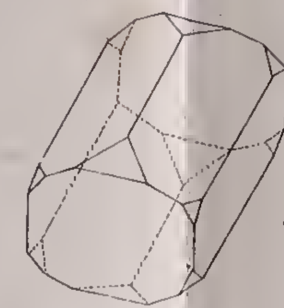


Fig. 68.



Cubic Zeolite.

Fig. 69

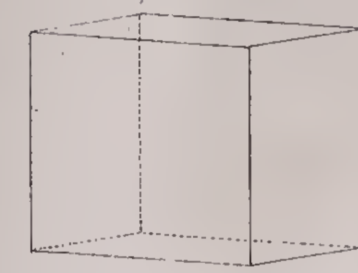


Fig. 70.

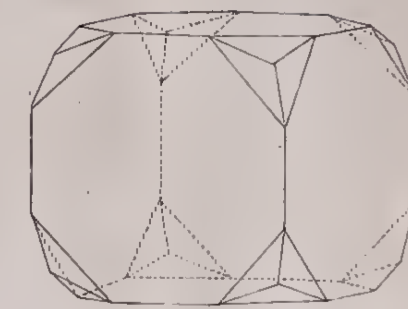
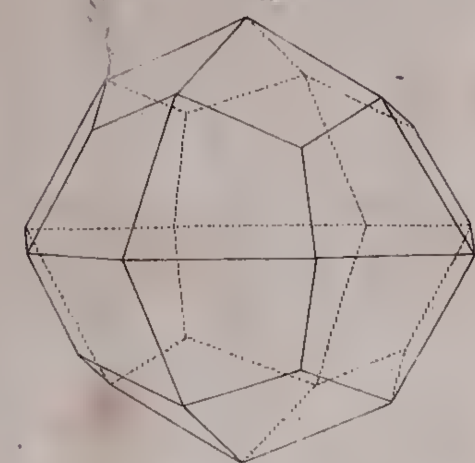


Fig. 71.



Cross Stone.

Fig. 72.

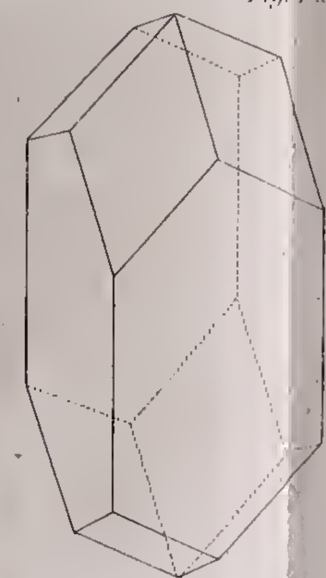


Fig. 73.

Felspar.

Fig. 71

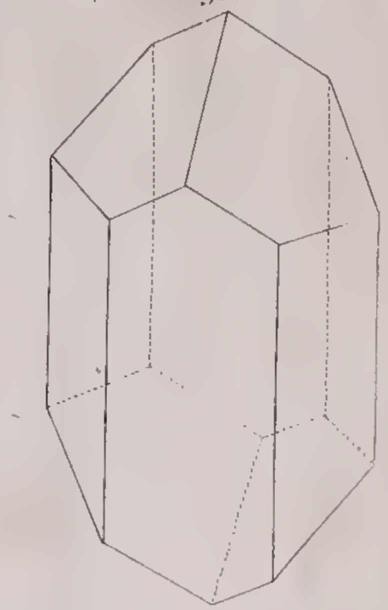
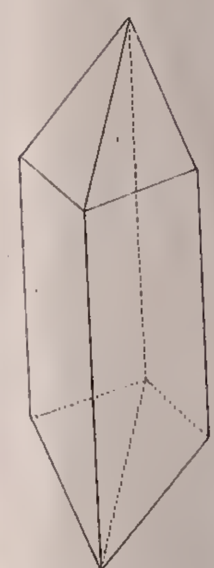
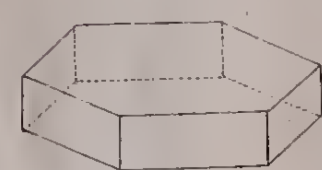


Fig. 75



Mica.

Fig. 76.



Basaltic Hornblende.

Fig. 77.

Fig. 78.

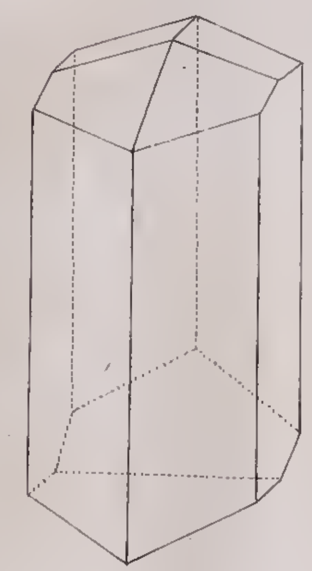


Fig. 79.

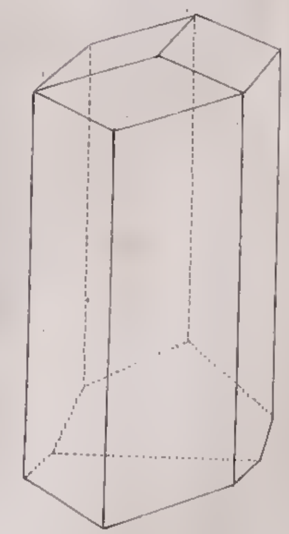


PLATE VI.

CALC-SPAR.

Fig. 80.

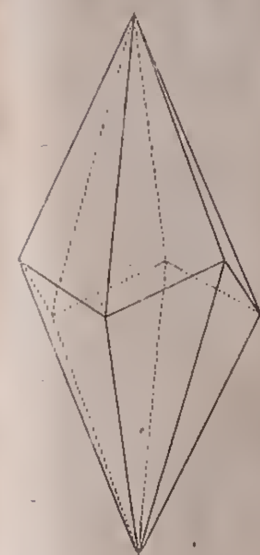


Fig. 81.

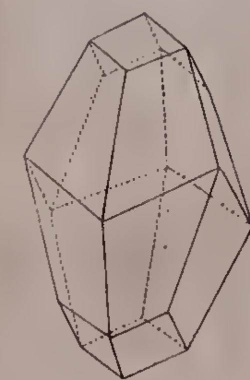


Fig. 82.

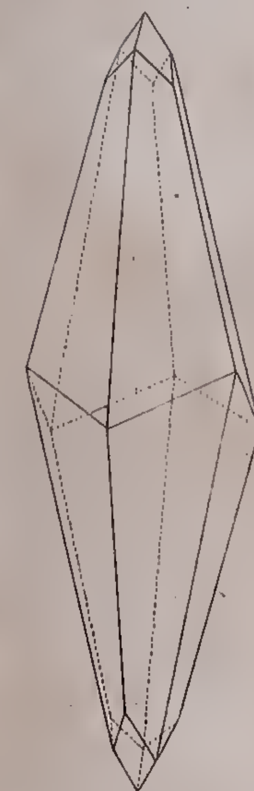


Fig. 83.

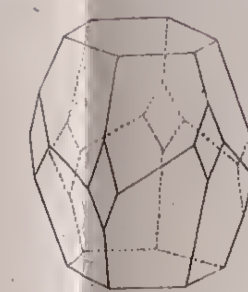


Fig. 84.

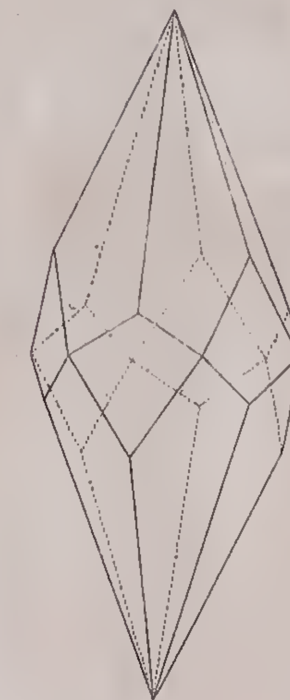


Fig. 85.

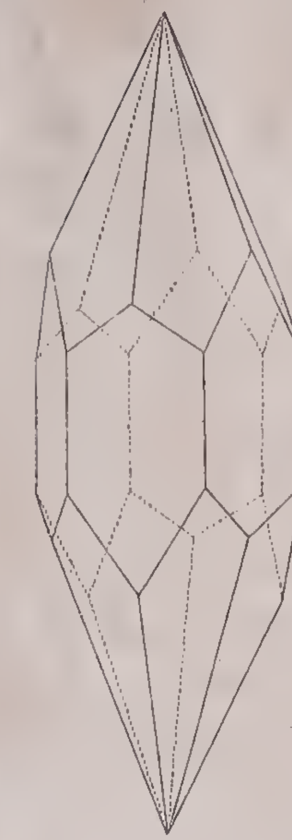


Fig. 86.

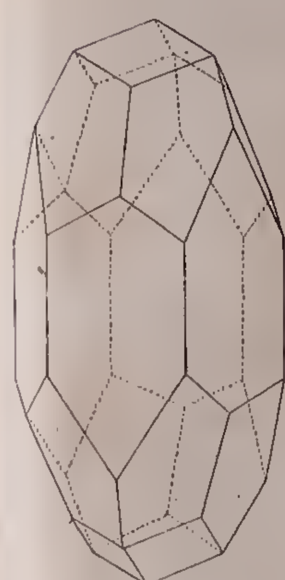


Fig. 87.

Fig. 88.

Fig. 89.

Fig. 90.

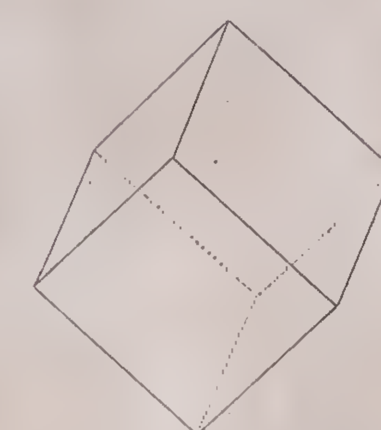


PLATE VII.

Fig. 91.

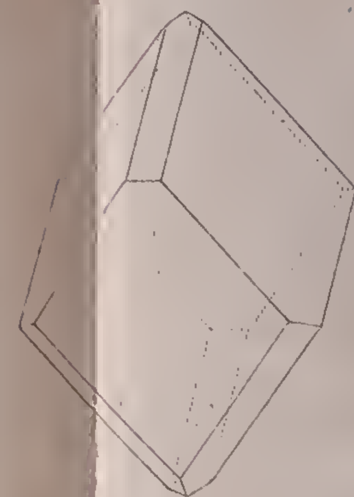


Fig. 92.

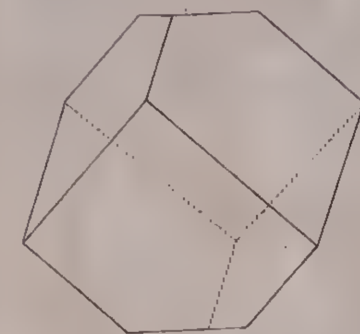


Fig. 93.

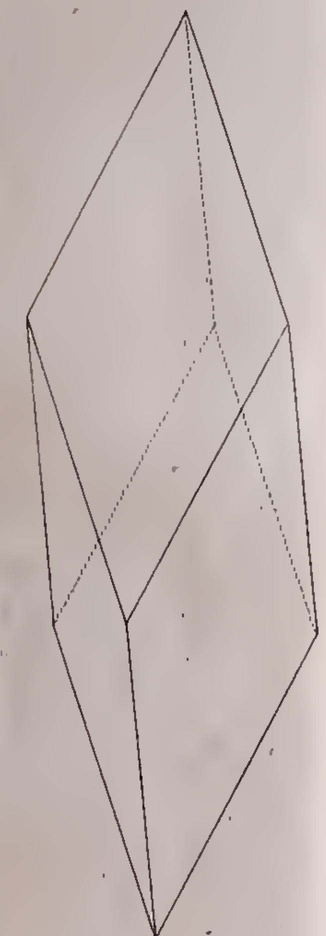


Fig. 94.

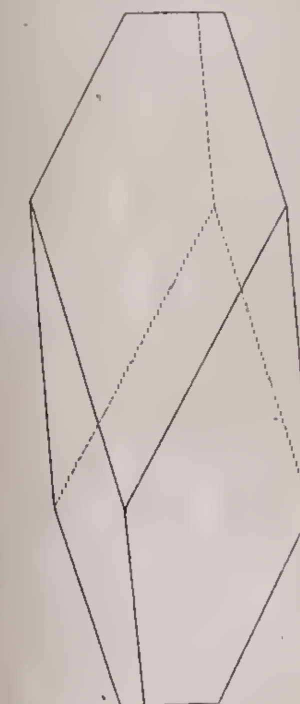
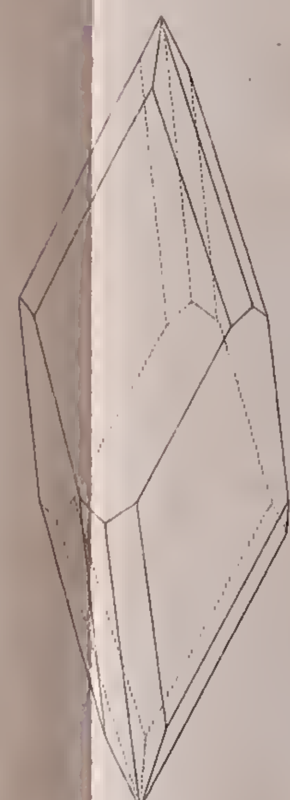


Fig. 95.

Fig. 96.



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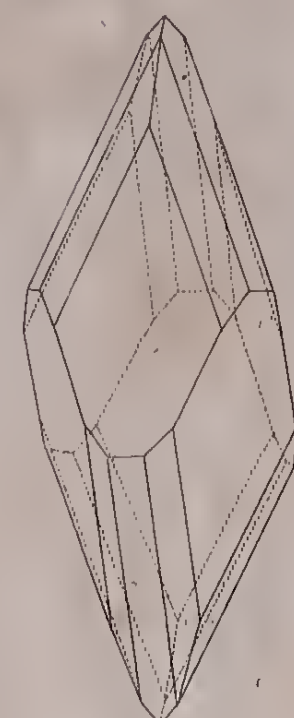
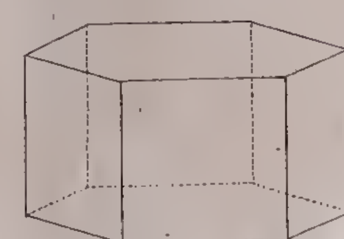


APPATITE.

Fig. 98.



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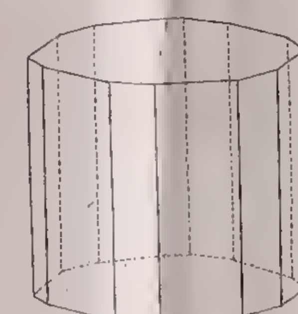

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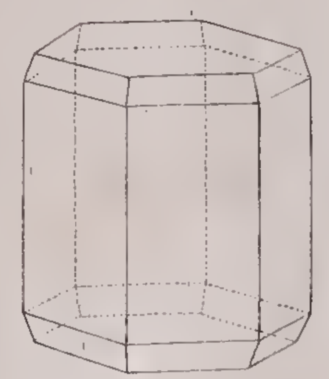

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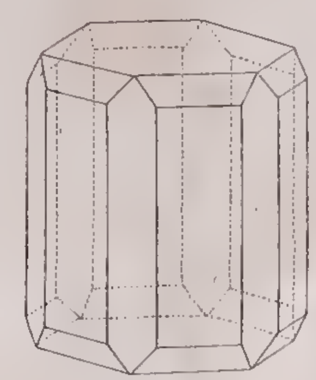


ASPARAGUS STONE.

Fig. 102.

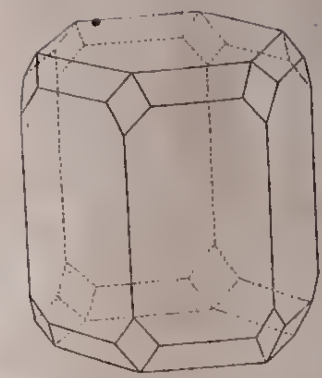


Fig. 103.

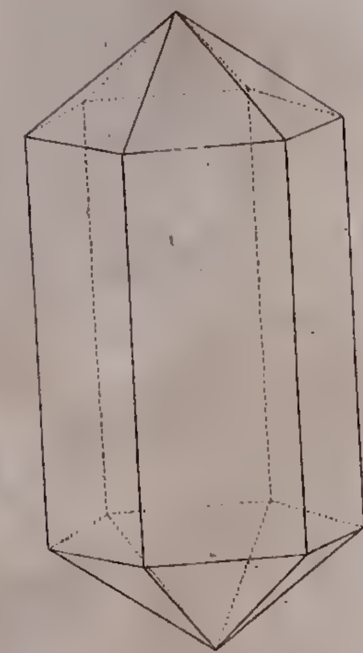
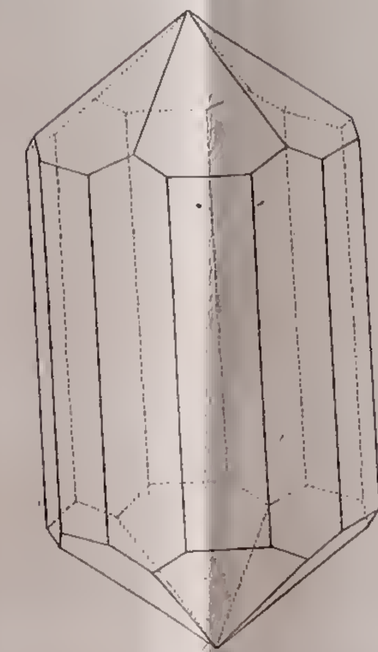
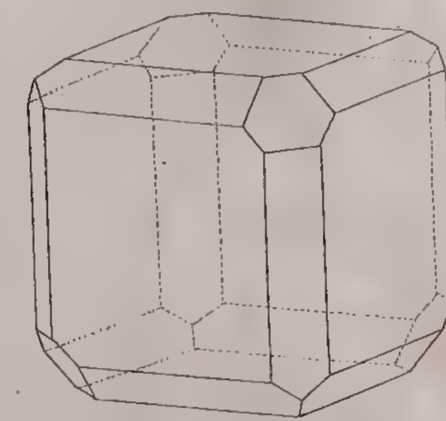


Fig. 104.



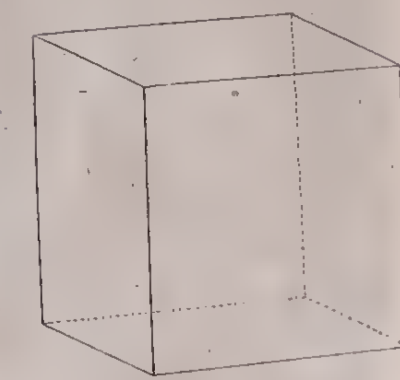
BORACITE.

Fig. 105.



FLUOR SPAR.

Fig. 106.



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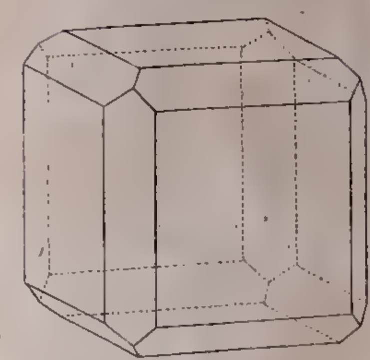

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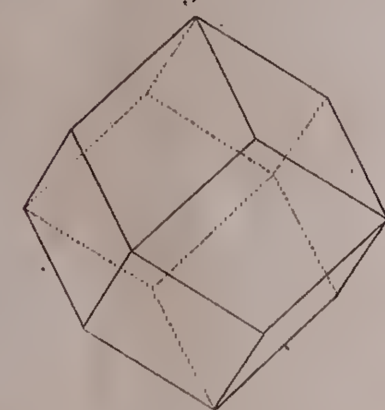


Fig. 109.

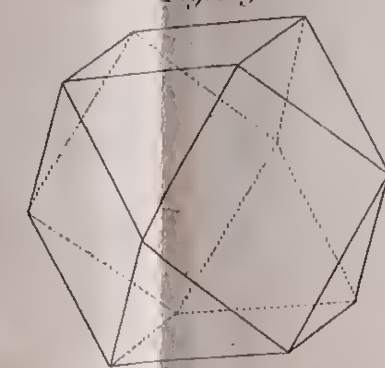
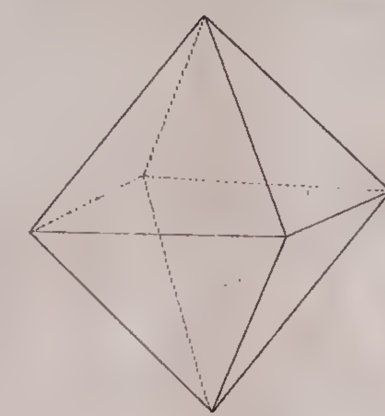


Fig. 110.



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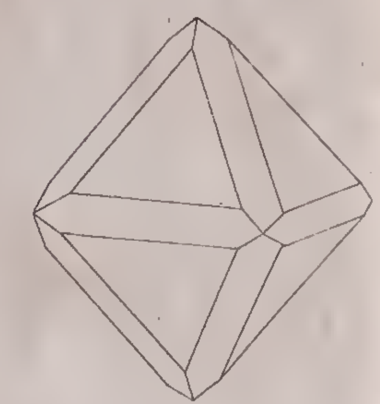

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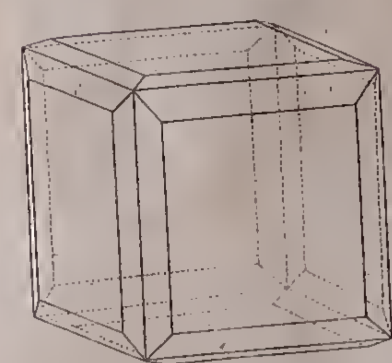

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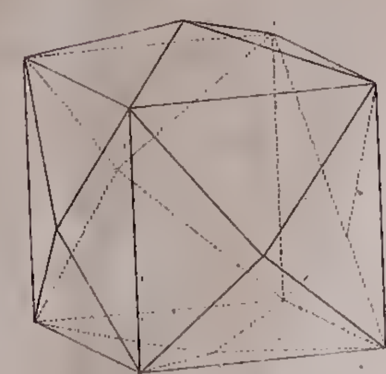


SELENITE.

Fig. 114.

Fig. 115.

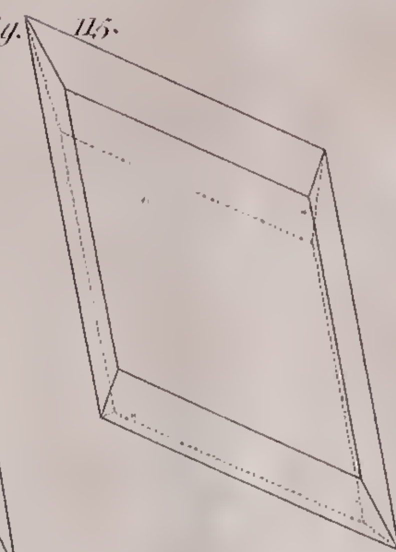
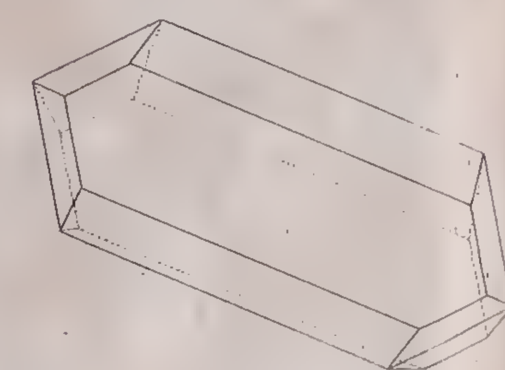


Fig. 116.



STRAIGHT LAMELLAR HEAVY SPAR.

Fig. 117.

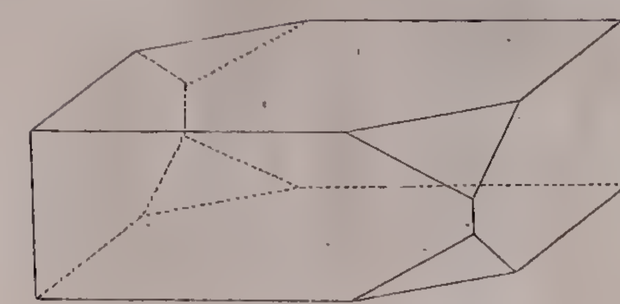
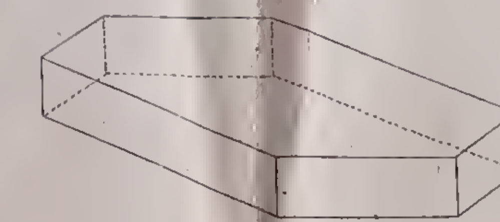


Fig. 118.



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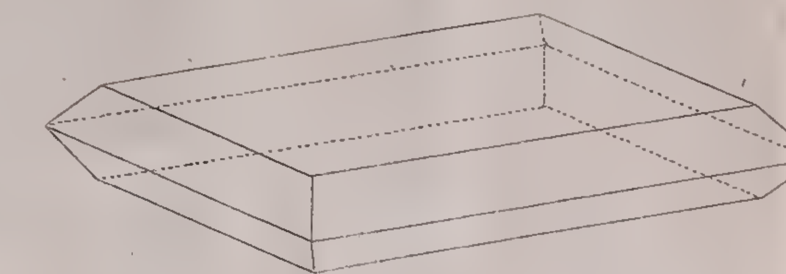


Fig. 120.

PRISMATIC HEAVY SPAR.

Fig. 121.

CELESTINE.

Fig. 122.

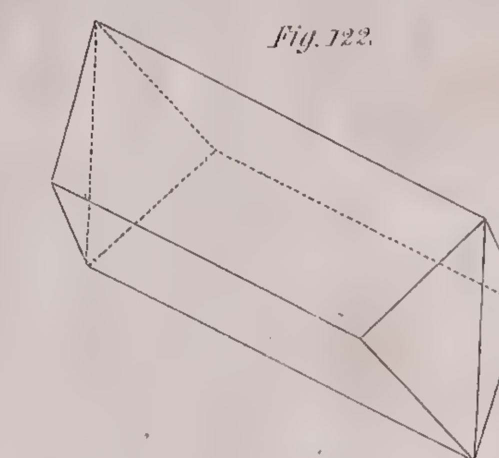


Fig. 123.

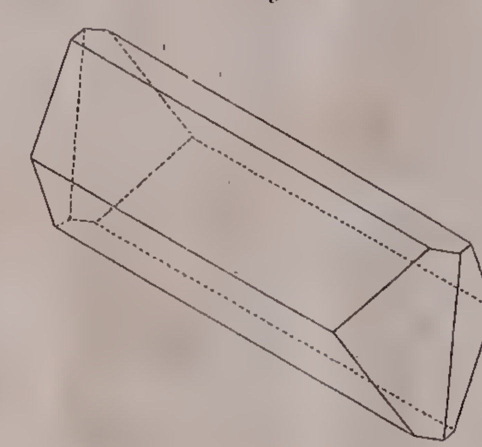


Fig. 124.

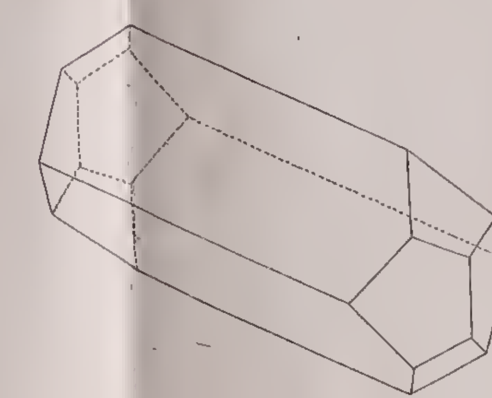
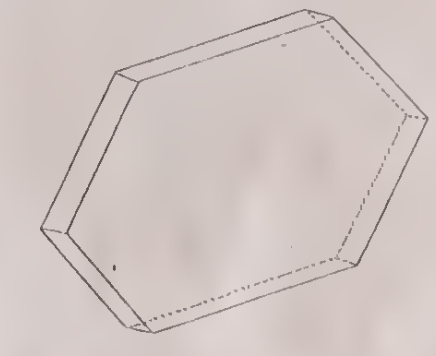
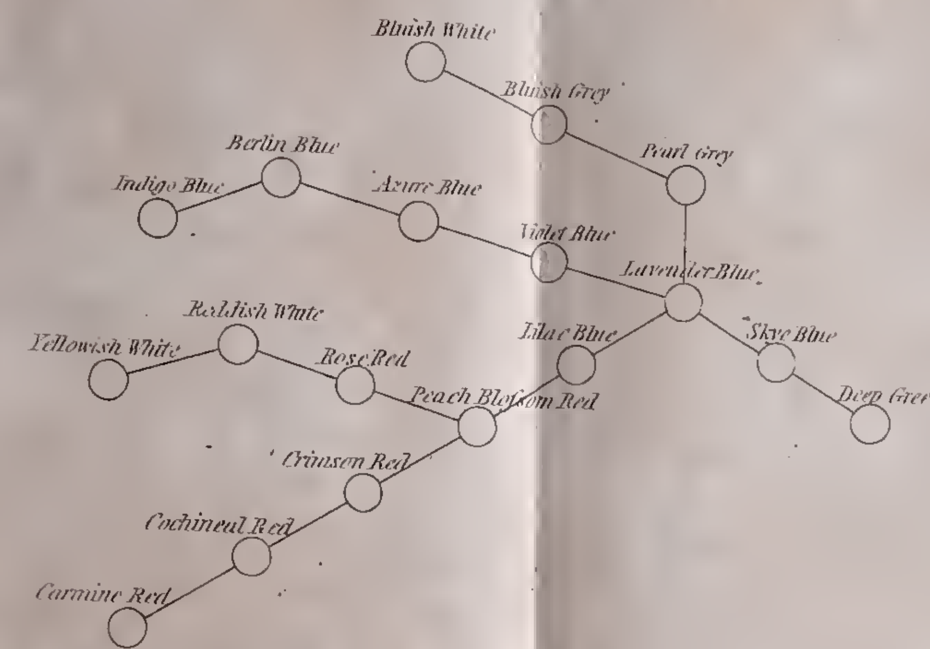


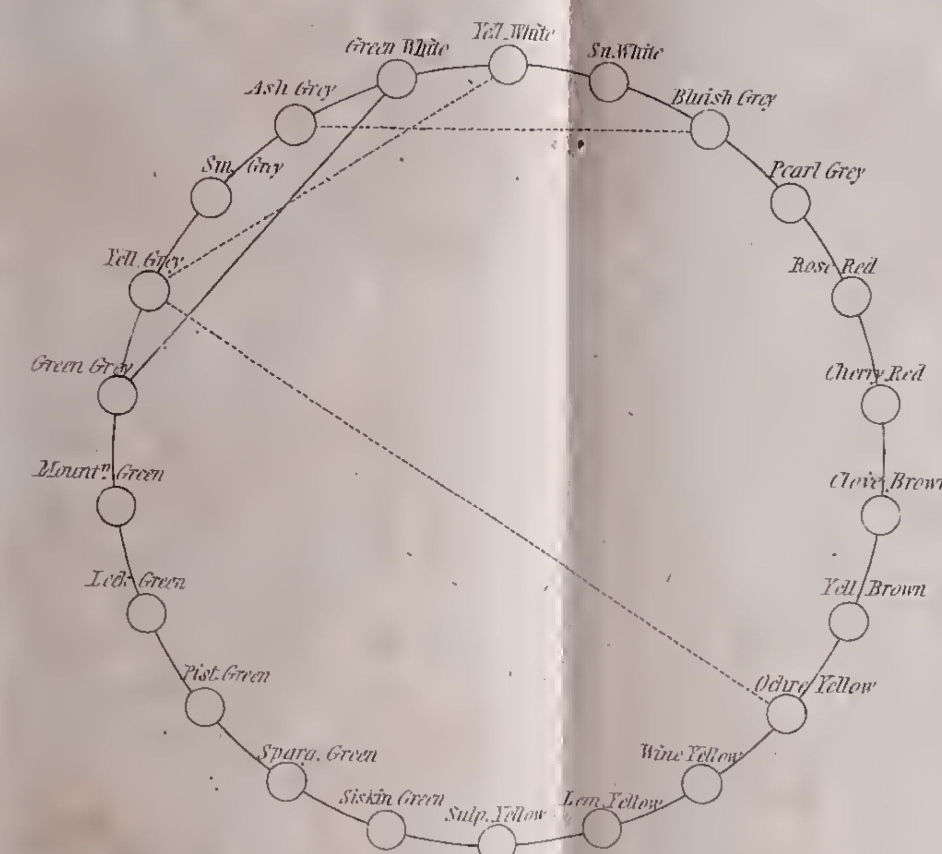
Fig. 125.



SAPPHIRE COLOUR SUITE.

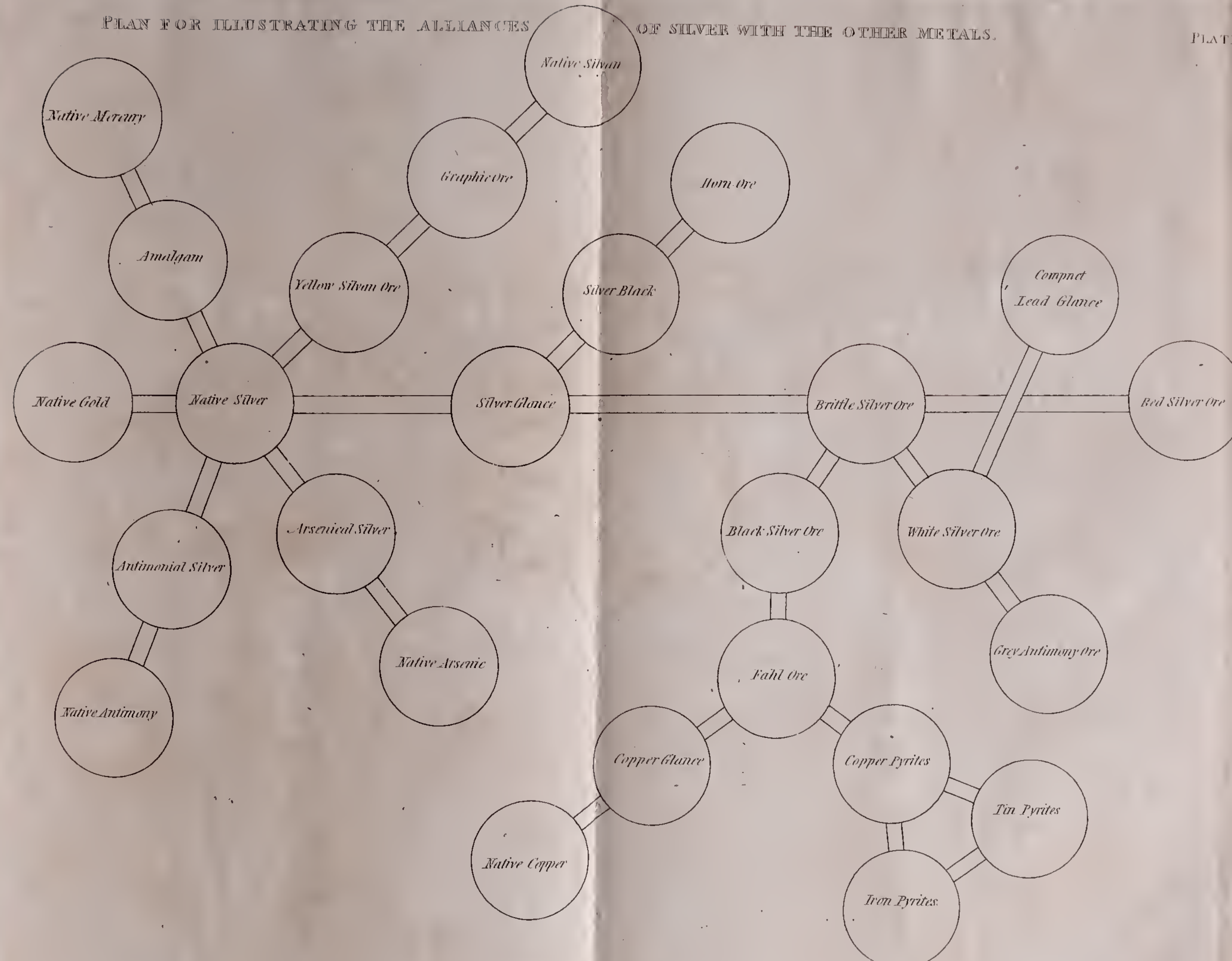


DIAMOND COLOUR SUITE.



PLAN FOR ILLUSTRATING THE ALLIANCES OF SILVER WITH THE OTHER METALS.

PLATE XI.



Q - 2 Vols.